Compre r

MARCH 1951

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IR
LITERATURE
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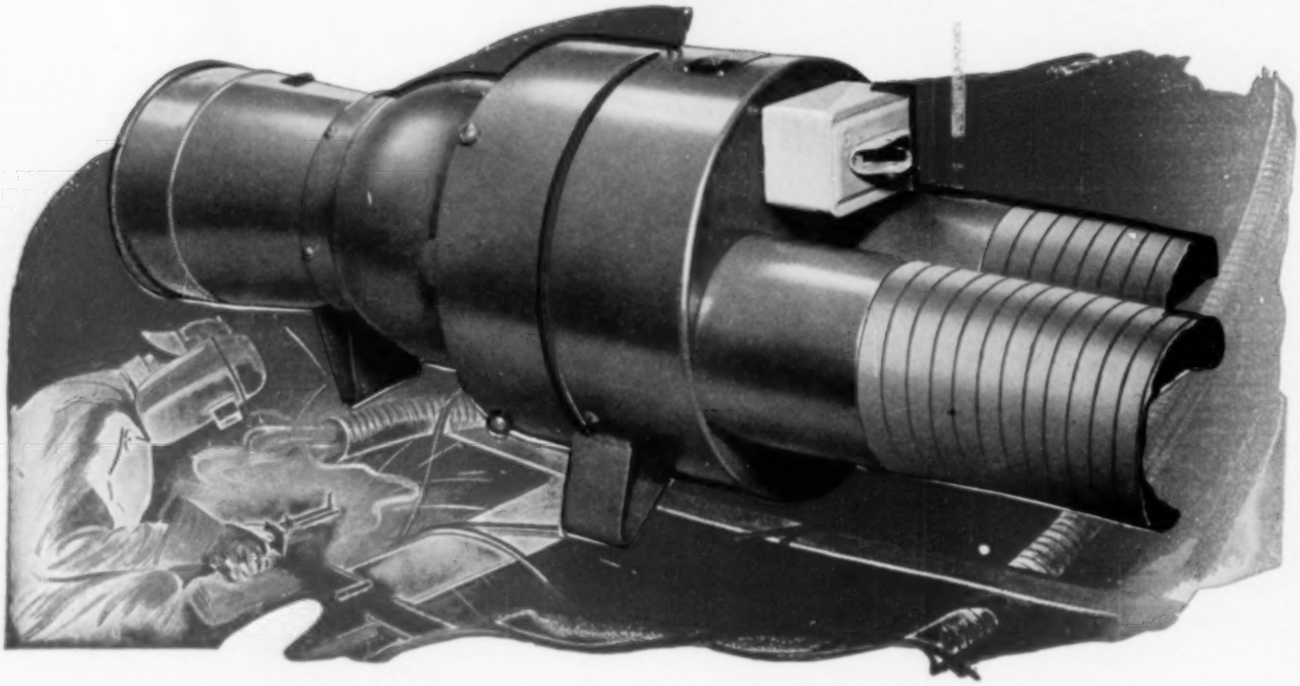
BRINK'S GLEN IN LITTLE TRAVELED NEW JERSEY AREA

Restful spot near the site of copper mine worked by the Dutch 300 years ago

VOLUME 56 • NUMBER 3 NEW YORK • LONDON

An Extra Lung for A Man

HAVING TROUBLE BREATHING



The amount of work a man can do goes *down* when foul air comes *in* or the heat goes *up*. Are you giving your workers the equipment that will keep them efficient even when working in hot or noxious fumes?

Many concerns regard Coppus Blowers as "production tools" as well as "safety equipment". They help men to do more work and better work.

You can find in the Coppus line the right blower or exhauster for each "bad spot"—or perhaps one type will handle a variety of jobs. In addition to man-cooling and removing fumes from confined places, Coppus Blowers are used for cooling and drying materials and equipment. They are portable . . . efficient . . . built to Coppus "Blue Ribbon" standards of construction and workmanship in order to withstand severe usage.

Check and mail the coupon for specific information. Coppus Engineering Corp., Worcester 2, Mass.

Sales Offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.

ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

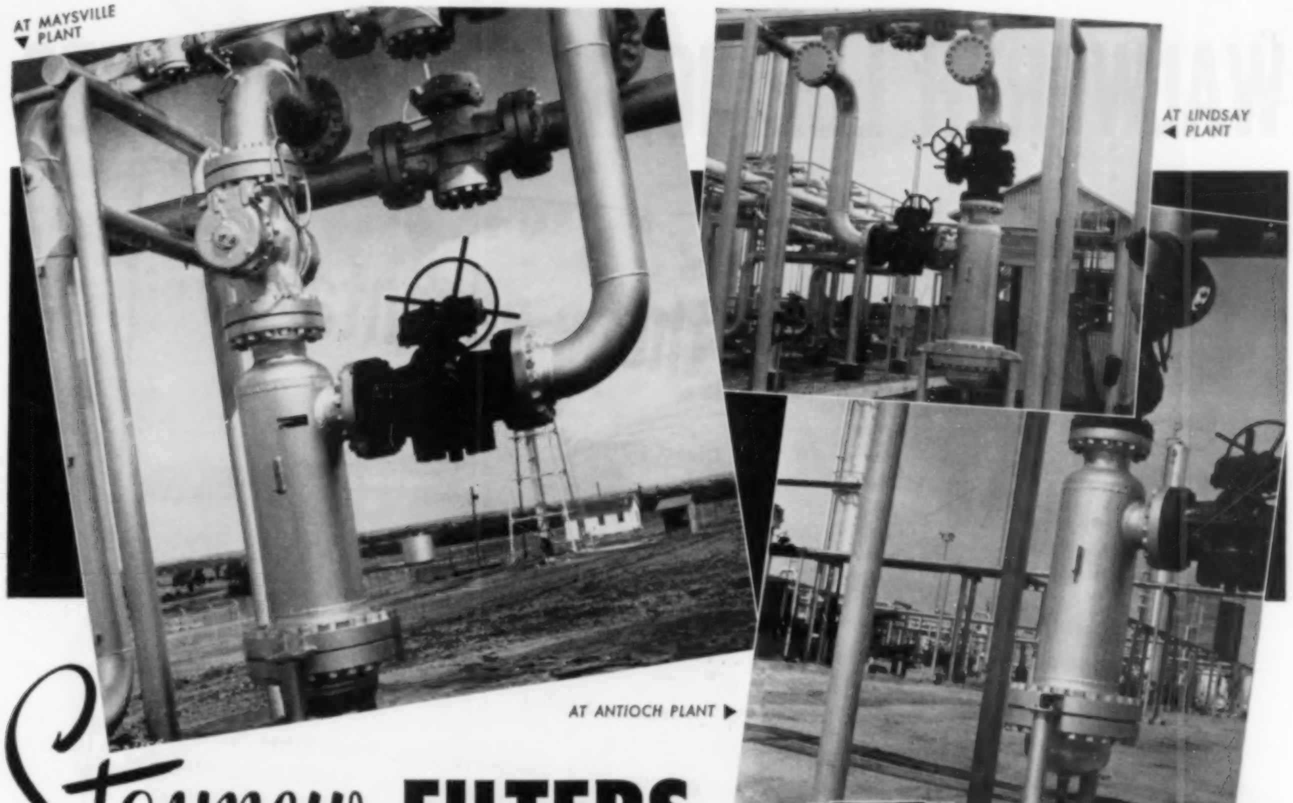
COPPUS ENGINEERING CORP., 203 PARK AVENUE, WORCESTER 2, MASS.
Please send me information on the Blowers that clear the air for action.

☐ in tanks, tank cars, drums, etc.
☐ in underground cable manholes.
☐ in aeroplane fusilages, wings, etc.
☐ on coke ovens.
☐ on steam-heated rubber processes.
☐ on boiler repair jobs.

COOLING:
☐ motors, generators, switchboards.
☐ wires and sheets.
☐ general man cooling.
☐ around cracking stills.
☐ exhausters, welding fumes
☐ stirring up stagnant air wherever men are working or material is drying.

NAME ....
COMPANY ....
ADDRESS ....
CITY ....

(Write here any special ventilating problem you may have).



Staynew FILTERS

in One of the World's Largest Oil Field Operations

Here's a typically tough Staynew-solved problem: at the new Garvin County plants, in Oklahoma's fabulous Golden Trend Area, highly abrasive aluminum oxide in lines carrying natural gas would cause serious damage if allowed to pass into the compressors. Staynew Filters in all three plants, processing a total of 40 million cu. ft. a day, remove all abrasive material and reduce compressor wear to a minimum.

Special construction was required in each filter to handle pressures frequently approaching 800 PSI. Since all three plants operate 24 hours a day, dual filter installations might be expected. However, due to the exclusive Staynew design, a single filter only was needed in each plant—and experience proves that servicing is necessary no oftener than twice a year.

What Is YOUR Filtration Problem?

The above group of filters represents only *one* of the thousands of Staynew installations in critical service throughout industry. In designing filters for these installations, an unsurpassed fund of specialized information has been acquired. This information is at your service. For help in solving *your* filtration problem, whether the requirement is clean air, gas, or liquid, contact your Dollinger representative, or write direct, c/o the Dollinger Testing Laboratory.

In Canada: Toronto—McCarthy and Robinson
Montreal—Engineering Equipment Co.
In France: Paris—Société Tecalemit

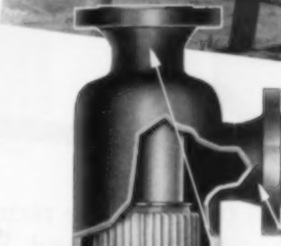


Diagram and Specifications of **STAYNEW FILTERS** in Service at Garvin County Plants

- **Inlet.**
- **Outlet.**
- **Forged steel shell, 7/8 in. thickness, certified for 800 lbs. pressure.**
- **Radial Fin Filter Inserts. Removable by simply unscrewing wingbolt after unbolting head.**
- **Bolted Head, 32 in. x 3½ in. flanges.**

Wt. 3425 lbs.

**DOLLINGER
CORPORATION**
7 CENTRE PK., ROCHESTER 3, N. Y.

DOLLINGER
REG. PROTECTOMOTOR U.S. PAT. OFF.
STAYNEW FILTERS

WALWORTH LUBRICATED PLUG VALVES

200 WOG
WALWORTH

offer these advantages

- . . . Direct port opening
- . . . Quarter turn opens or closes valve
- . . . Dead tight shut-off
- . . . Freedom from attack by fluids being handled
- . . . Pressure sealed
- . . . Made in a complete line. Sizes from ½" to 24" for pressures from 175 to 5,000 psi., and for vacuum requirements

THESE are just a few of the reasons why Walworth Lubricated Plug Valves give "top" performance on many *difficult* services.

All Walworth Lubricated Plug Valves employ special insoluble lubricants which protect the plug and body against contact with the line fluid, thus combatting erosion and corrosion.

The lapped surfaces of the valve are "pressure sealed" when the valve is in either the open or closed position. By turning the lubricant screw, lubricant is forced under high pressure through a grooving system that completely encircles the ports as well as the top and bottom of the plug.

The lubricant seals the valve against leakage, and reduces friction between plug and body. This permits easy, quick, full-opening, or tight shut-off with only a quarter turn of the plug.

Number 1700 (illustrated) is a Steel-iron valve, wrench operated, designed for a working pressure of 200 pounds WOG (water, oil, or gas). Valves are available in either screwed or flange types. Screwed type have API line pipe thread lengths. Flanged type (No. 1700F) is faced and drilled to American Standard for 125-pound cast iron flanges unless otherwise specified.

For further information about No. 1700 as well as the complete line of Walworth Lubricated Plug Valves, write for catalog.

WALWORTH
valves and fittings
60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

UNION OIL COMPANY
cuts cylinder wear,
lengthens service of
equipment with...

...KOPPERS
***K-Spun* Porous**
Chrome* PISTON
RINGS

Koppers K-Spun Piston Rings, produced by an exclusive centrifugal casting process, are 100% stronger and four times more resistant to combustion shock than ordinary cast iron rings, and will not break in installation or in service.

Koppers Porous Chrome Rings have a porous chrome surface that holds and distributes oil during break-in, quickly wears down to perfectly seated solid chrome that prevents grit and other particles from embedding in the ring surface where they can scratch cylinder walls. Porous Chrome Rings last up to four times as long as other rings, reduce cylinder wear 50% or more.

That's why hundreds of companies like Union Oil are reporting amazing savings in equipment and maintenance costs through the use of Koppers Rings. Remember . . . we make rings for *anything* that uses piston rings.

If you have a piston ring problem, why not get the *right* answer from us? Write, wire or phone Koppers Co., Inc., *Piston Ring Dept.*, 1513 Hamburg St., Baltimore 3, Maryland.

Union Oil Company's newly modernized Avila (California) Terminal utilizes three 460 h.p. Enterprise dual-fuel engines with single-stage Ingersoll-Rand SHV centrifugal pumps. Engines are 6 cylinder, 12" bore, 15" stroke, 4 cycle, 450 rpm, non-supercharged. Each piston is fitted with two Porous Chrome, three tapered and two oilcutter Koppers Piston Rings.

KOPPERS

KOPPERS
AMERICAN HAMMERED
PISTON RINGS

*VAN DER HORST PROCESS

ONLY KOPPERS CAN FURNISH K-SPUN OR POROUS CHROME!

Take a *whale* of a bite out of power costs!

V-Belts by

put cost-cutting teeth in your V-Belt drives with DAYTON COG-BELTS*

40% MORE H.P. PER BELT **FEWER BELTS**

FEWER PULLEY GROOVES **LONGER BELT LIFE**

There's a whale of a saving in power transmission costs when you use the premium Dayton Cog-Belt! It delivers 40% more h.p. than an ordinary V-Belt. Here's why—

Cog-Belts are built to bend—like your finger—to take up compression strains as the belt goes round the pulleys. Results: Less strain, less heat, less stretch, less maintenance, longer life, less down-time.

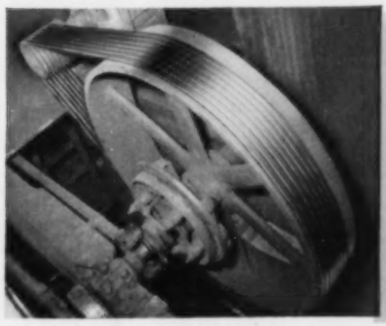
Save on the cost of original belting! You need fewer belts, fewer pulley grooves to do the job, when 5 Dayton Cog-Belts do the work of 7 ordinary V-Belts,—and do it better!

Save drive-space, plant space! Cogs permit much shorter center-to-center distances—up to 25% shorter. They save up to 47.2% in drive area.

To end your V-Belt troubles for the long "duration" ahead, give your Dayton Distributor the "high-sign" of better V-Belt power transmission: the arched finger that means Dayton Cog-Belts and important savings!

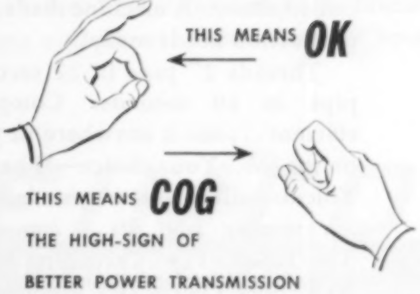
*T.M.

DAYTON RUBBER COMPANY • DAYTON 1, OHIO



TAKE A TIP FROM A TIPPLE

14 years ago a set of Dayton Cog-Belts went to work, running the tipple at a coal mine at Logan, W. Va. These same veteran Cogs are still on the job! The mine superintendent predicts that they are good for years to come. If you have a drive that's a real toughie, turn it over to a team of Dayton Cog-Belts, for a long, trouble-free life!



Dayton Rubber

WORLD'S LARGEST MANUFACTURER OF V-BELTS

"Long life... Low upkeep!" ....say users of TOLEDO 2" Portable Power Pipe Machines

◆20 YEARS! "These two Toledo #999 Machines have been in continuous hard service for more than 20 years with only routine service attention," says P. E. Hayes of J. M. Hengy Electric Co., Dallas, Texas. "All our pipe threading tools, both power and hand, are and will be Toledo." Photo taken on Dallas Power and Light Co. job.

25 MACHINES! Tooled for high production—Farwell Company, Inc., plumbing and heating contractors in Dallas, Texas, have 15 Toledo #999 Machines, 5 Toledo 2" High Speed Machines and 5 Toledo #1-2-4 Power Pipe Machines. Photo shows work on Southern Methodist University job.

Speed Production . . .

It's *5 times faster than hand methods*—this rugged-performing TOLEDO No. 999 2" Power Pipe Machine! Job-proved by thousands of users—progressive outfits like the Texas contractors described above. A machine that's *right* for your high-production needs today!

Threads 2" pipe in 22 seconds . . . cuts off 2" pipe in 10 seconds. Compact . . . portable . . . efficient . . . use it anywhere in your shop, plant or on the job. Your choice—Wheel or Knife Cut-Off. Toledo-built with the know-how of nearly 50 years . . . assuring *long life . . . low upkeep.* Write for catalog. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.

RELY ON THE LEADER TOLEDO

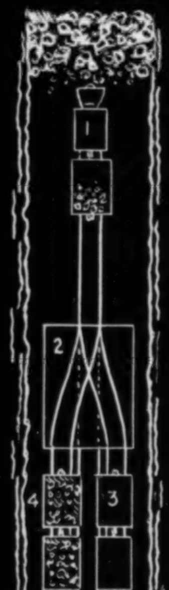
PIPE TOOLS...POWER PIPE MACHINES...POWER DRIVES

CASE HISTORY OF A SUCCESSFUL TUNNEL JOB

FROM THE EIMCO FILE T64

CONTINENTAL DIVIDE TUNNEL

The Continental Divide Tunnel (also known as the Alva B. Adams Tunnel) was driven on contract by three different contractors all using Eimco equipment for loading. Total length 13.3 miles, no intermediate openings. Longest contract 42,995 ft. Avg. advance per month for 37 months on longest contract — 1144'.



Interesting facts about this tunnel include: 1,800,000 man hours of labor were required to excavate the 310,000 yards of material, 480 miles of drill holes were required and 1,240 tons of powder were used.

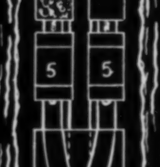
For switching cars at the heading a double track passing switch was built to slide along on top of the permanent track. See illustration at left: 1. Eimco Model 21 Loader. 2. Double track switch mounted on plate to slide on permanent track. 3. Empty cars. 4. Loaded cars. 5. Locomotive.

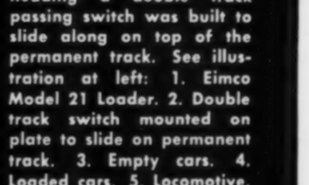
Successful tunneling is dependent on arriving at a satisfactory cycle of drilling, blasting and mucking, then repeating the cycle as fast and as often as possible.

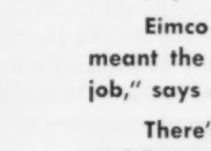
Contractors who have been most successful in working out this formula have been most emphatic in saying that dependable equipment means most in maintaning the pace that pays dividends.

Eimco equipment for loading is dependable. "It's meant the difference between success and failure on our job," says one superintendent.

There's an Eimco Rocker Shovel for every size tunnel and for speed, economy and dependability you can't beat an Eimco.


MODEL 12-B


MODEL 40 H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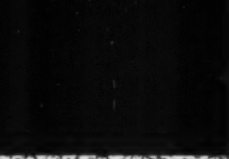
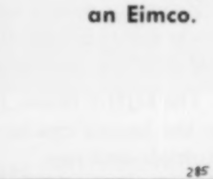
MODEL 21


MODEL 15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EIMCO

THE EIMCO CORPORATION

The World's Largest Manufacturers of Underground Rock Loading Machines
EXECUTIVE OFFICES AND FACTORIES — SALT LAKE CITY 10, UTAH, U. S. A.

BRANCH SALES AND SERVICE OFFICES:
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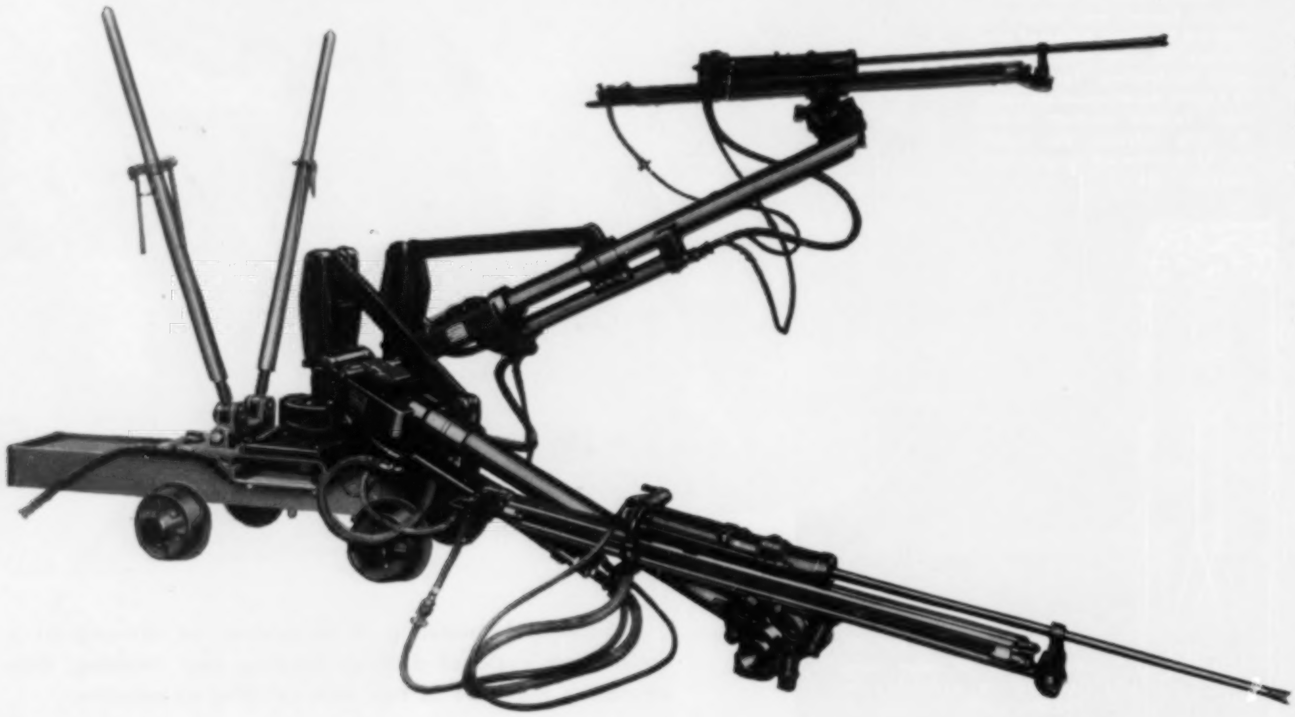
EL PASO, TEXAS, MILLS BUILDING • BERKELEY, CALIFORNIA, P. O. BOX 240
KELLOGG, IDAHO, 307 DIVISION STREET

IN FRANCE: SOCIETE EIMCO, PARIS, FRANCE
IN ENGLAND: EIMCO (GREAT BRITAIN) LTD., LEEDS 12, ENGLAND
AGENTS IN ALL PRINCIPAL CITIES THROUGHOUT THE WORLD

Convert set-up time into drilling time

with the **NEW**

DJB-2 boom jumbo



Field reports prove that this air-operated **BOOM JUMBO** *will drill out a round* **IN ONE-THIRD LESS TIME** *than with conventional column-and-arm methods*

With this compact, air-powered Boom Jumbo, there's no more wrestling with heavy arms and machines every time you move the drill for a new hole. At the touch of a lever, an I-R air motor raises or lowers the boom to any desired position in a matter of seconds. Lateral movement is as easy as swinging a door—yet is rigidly locked in position by a single-bolt tapered-joint locking device. Universal ceiling jacks are easily and quickly placed, regardless of ceiling height or contour. (Hydraulic Jack available upon request.)

Power for raising and lowering the booms is transmitted by a self-locking screw drive, acting on a sliding sleeve. This rugged construction will take lots of abuse, and is not easily affected by acid mine water or muck.

The DJB-2 Boom Jumbo is available as a complete, car-mounted unit, or the booms can be furnished separately for installation on single- or multiple-unit rigs.

The illustrated long-lived 48-inch-feed aluminum shells are ideal for use with Ingersoll-Rand Carset Jackbits. Longer feeds are provided for places where they can be utilized.

ROCK DRILLS
COMPRESSORS
AIR TOOLS
TURBO-BLOWERS
CONDENSERS
CENTRIFUGAL PUMPS
DIESEL & GAS ENGINES

Ingersoll-Rand

11 Broadway, New York 4, N. Y.

579-5

Compressed sales story for compressors:

"TIMKEN® *bearing equipped*"

INGERSOLL-RAND *Mobil-Air compressor shown here is powering tools used to penetrate shale for the installation of sewer and drainage tile. Timken bearings insure long life, minimum maintenance.*

WHEN a man shops for compressors he's most apt to buy the one that offers the greatest assurance of long life, trouble-free performance and minimum maintenance. That's why Ingersoll-Rand equips the wheels and crankshafts of its portable air compressors with Timken® tapered roller bearings.

Timken bearings keep crankshafts in positive alignment, free from excessive deflection and end-play. Wear on surrounding parts is reduced. And because Timken bearings are manufactured to incredible precision, they permit closures that more effectively keep out dirt and retain lubricants.

Timken tapered roller bearings carry any combination of radial and thrust loads. Line contact between rollers and races provides maximum load-carrying capacity. Timken bearings are made from the finest steel ever developed for tapered roller bearings—Timken fine alloy steel. Thanks to advanced design and materials, they normally last the life of the machine.

With over 50 years of bearing research behind them, Timken bearings are industry's first choice. No other bearing gives you *all* the advantages you get with Timken bearings. The trade-mark "Timken" is your best guide to quality. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

WE MAKE OUR OWN STEEL

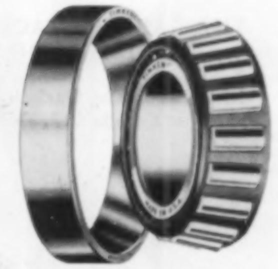
The special grade alloy steel which gives Timken bearings their strength and resistance to wear, is made in our own steel mills.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL AND THRUST → ← LOADS OR ANY COMBINATION

Preferred — because of:

In a recent nation-wide industrial survey over half of those interviewed gave GARLOCK as their first choice for packings and gaskets. The main factors influencing their choice are listed at the right.

Illustrated above are a few widely used Garlock products: **A.** Garlock 950 Gaskets, cut from Compressed Asbestos Sheet; **B.** Garlock 150 High Pressure Packing; **C.** Garlock 731 Lattice-Braid Coil Packing; **D.** Garlock 430 *Chevron** Packing; **E.** Garlock *Bitan** Leather Cups; **F.** Garlock 875 Gas Compressor Metal Packing — all of uniform high quality for *dependable* performance.

*Reg. U. S. Pat. Off.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company
of Canada Ltd., Montreal, Que.

1. Research

Garlock research brings improved products to meet changing needs.

2. Quality

High quality is assured by quality-controlled construction throughout.

3. Service

Helpful service calls by Garlock representatives and complete factory co-operation.

4. Complete Line

There are Garlock products for every kind and type of service.

5. Long Life

Garlock products give long, dependable service because of their uniform fine quality.

GARLOCK

**PACKINGS, GASKETS
AND OIL SEALS**

WIRE ROPE

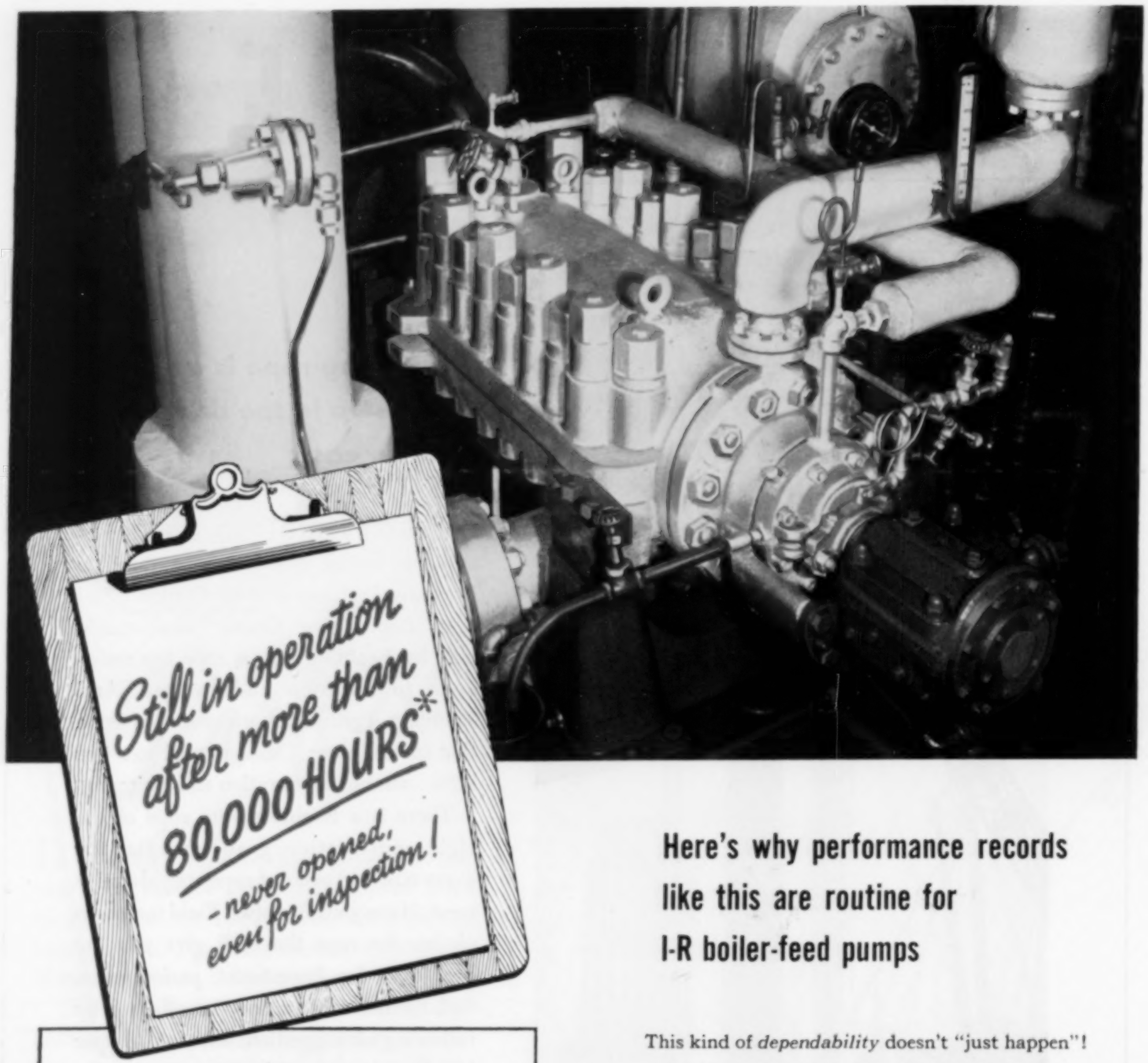
Roebling rope is a big help in the drive for lower costs

FOR EASY HANDLING, extra toughness and service life, there's nothing like Roebling Preformed "Blue Center" Steel Wire Rope. "Blue Center" steel—made only by Roebling—gives rope top resistance to abrasion and fatigue. And Roebling Preforming gives you a rope that spools better... doesn't tend to set or kink... minimizes vibration and whipping.

There is a Roebling wire rope of the right construction, grade and size for every type and make of rope-rigged equipment. Have your Roebling Field man help choose the rope that will give you the best and the lowest-cost performance. Still further savings may be effected by following his suggestions about the proper installation, use and maintenance of wire rope. John A. Roebling's Sons Company, Trenton 2, New Jersey.

ROEBLING

Atlanta, 934 Avon Ave ★ **_Boston,_** 51 Sleeper St ★ **_Chicago,_** 5525 W. Roosevelt Rd ★ **_Cincinnati,_** 3253 Fredonia Ave ★ **_Cleveland,_** 701 St. Clair Ave, N.E. ★ **_Denver,_** 4801 Jackson St ★ **_Houston,_** 6216 Navigation Blvd ★ **_Los Angeles,_** 216 S. Alameda St ★ **_New York,_** 19 Rector St ★ **_Odessa, Texas,_** 1920 E. 2nd St ★ **_Philadelphia,_** 230 Vine St ★ **_San Francisco,_** 1740 17th St ★ **_Seattle,_** 900 1st Ave, S. ★ **_Tulsa,_** 321 N. Cheyenne St



Here's why performance records like this are routine for I-R boiler-feed pumps

This Ingersoll-Rand Class HT pump No. 7C was installed in 1938 in the Windsor Station. Windsor Station is owned jointly by The Ohio Power Company (American Gas and Electric System) and the West Penn Power Company. Since that time the pump has chalked up a service record of 82,659* hours of operation – pumping rated capacity of 1025 gpm to approximately 1900 psi discharge pressure from suction conditions of 415 psi and 380° F.

It has never been opened for inspection.

This is one of six I-R high-pressure boiler-feed pumps at the Windsor Station. The others are giving fine performance also. Four of these were installed in 1941. Here are their records*:

Pump No. 7D	60,277 Hours
Pump No. 8A	53,880 Hours
Pump No. 8B	56,357 Hours
Pump No. 8C	65,063 Hours
Pump No. 8D	37,049 Hours

** Hours of operation up to October 1, 1950*

This kind of *dependability* doesn't "just happen"!

It's the end result of the extra care and precision, and the many years of experience that go into every step of Ingersoll-Rand pump manufacture – from selection of raw materials to final acceptance tests.

And it's here – on the job in leading power plants throughout the Nation – that I-R boiler-feed pumps have repeatedly proved their superiority for continuous, trouble-free, high-pressure service.

Whatever your boiler-feed application, there's an Ingersoll-Rand pump that's *right* for the job – a pump you can install with complete confidence in its sustained, high-efficiency performance. Your nearest I-R representative will be glad to give you complete information.

COMPRESSORS • AIR AND ELECTRIC TOOLS • ROCK DRILLS • TURBO BLOWERS
CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

Ingersoll-Rand
CAMERON PUMP DIVISION 569-10
11 BROADWAY, NEW YORK 4, N. Y.

Bethlehem Hollow Drill Steel

It Has Every Important Feature

★ Ideal for either forged or detachable bits
★ Center hole is smooth, true, and well-centered
★ Wide quenching range for easy heat-treating
★ Controlled hardenability and grain size
★ Made from tough, fatigue-resisting steel

For Immediate Delivery

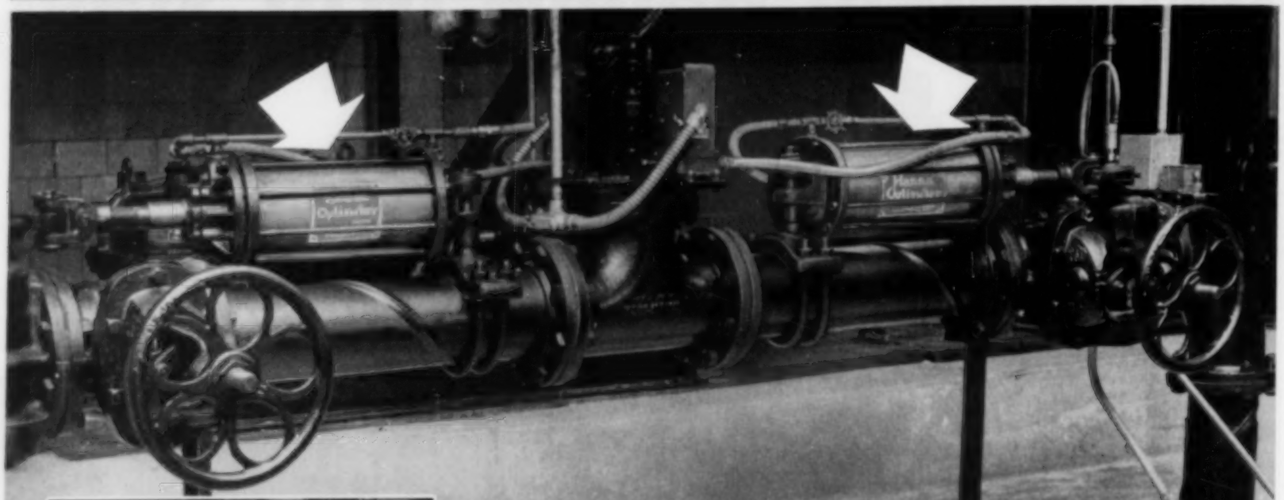
HOLLOW DRILL STEEL—SOLID DRILL STEEL
QUARRYING STEELS—AUGER DRILL STEEL
STONE-DRESSING STEELS

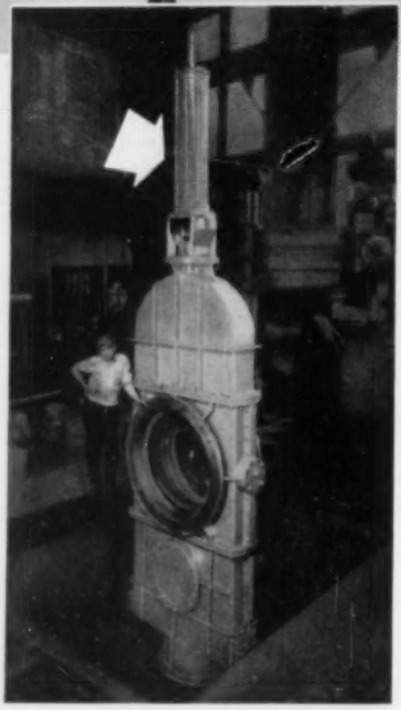
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM
STEEL

VALVES TO CONTROL?





Hanna®
Cylinder Power
is the easy-does-it-way

WHAT about your plant? Are there valves in hard-to-reach places requiring considerable time and trouble — or risk of injury — to operate by hand? Complicated piping arrangements don't always provide for positioning of valves at desirable locations. But, there is an efficient, economical solution to this problem—with Hanna Pneumatic or Hydraulic Cylinder Power.

Cylinders operating inaccessible valves may be actuated by hand or solenoid valves. Pilot valves and speed control valves in the circuit afford safety and regulated speed where such are essential. Panel type valves are offered where centralized control is desirable.

There is a standard Hanna Cylinder to meet almost every requirement. Cylinder operation of your valves may hold the possibility of effecting economies in your operation.

Our 50 years' experience in the application of cylinder power is available to you without obligation. Why not let our engineers solve your problems?

50th Anniversary 1901-1951

Hanna Engineering Works

HYDRAULIC AND PNEUMATIC EQUIPMENT . . . CYLINDERS . . . VALVES . . . RIVETERS

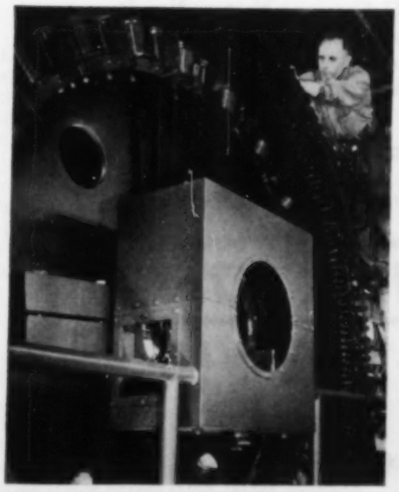
1765 Elston Avenue, Chicago 22, Illinois

Elliott
FABRI-STEEL
MOTORS AND
GENERATORS

Another big low-speed motor by...

ELLIOTT

A large low-speed engine type synchronous motor with split rotor, for driving Ingersoll-Rand type PRE reciprocating gas compressor.



Close-up of the pressurized explosion-resisting collector ring enclosure.

This big motor is rated 2000 hp, 164-rpm, 4000 volts, 3 phase, 60 cycle, 50 C rise, 1.0 power factor. The split rotor facilitates assembly on the compressor shaft in the field. Collector rings are enclosed, adapting the unit to duty in explosive gas atmosphere.

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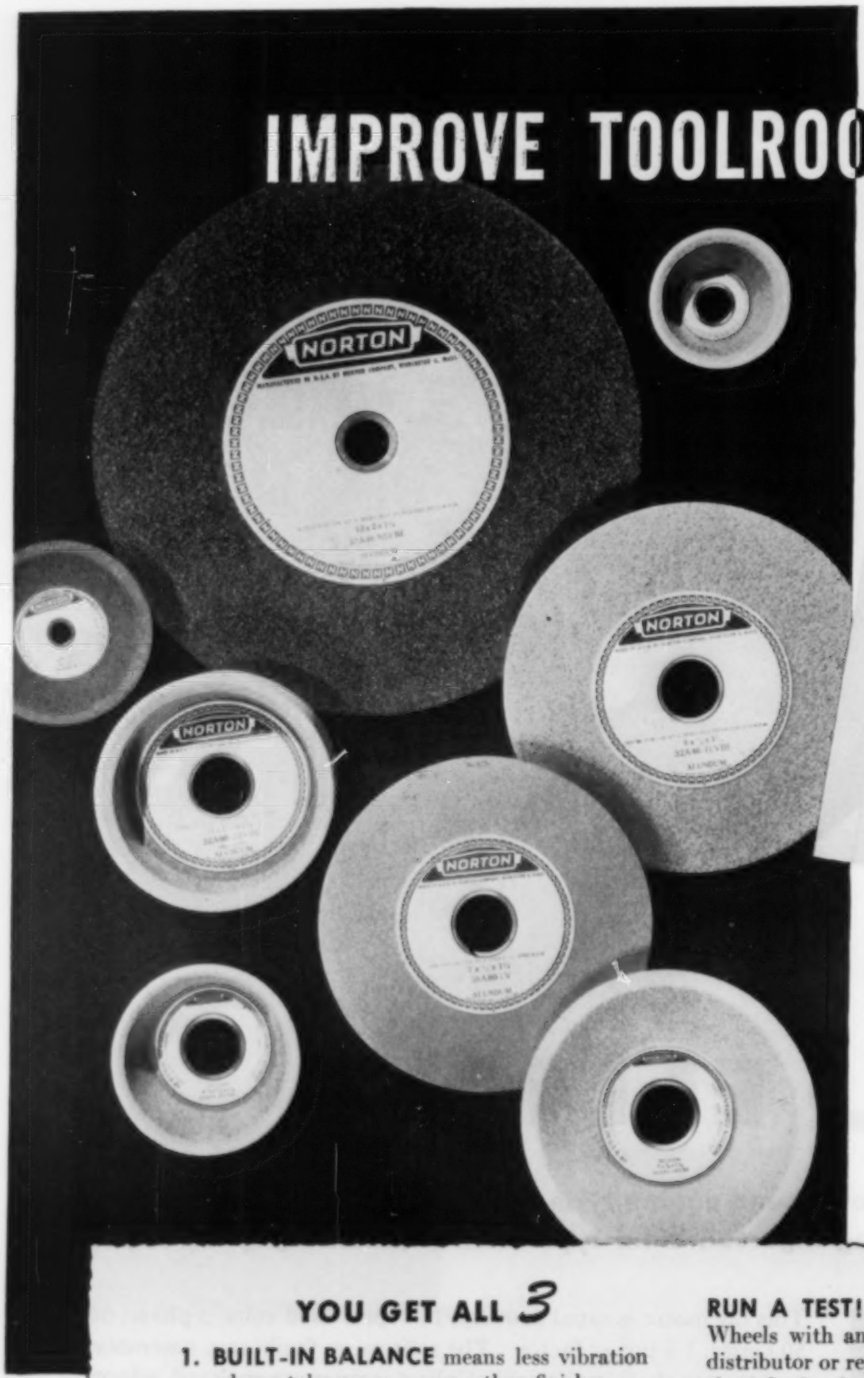

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ON THE COVER

NEW YORKERS who travel far in search of seclusion could save a lot of time by merely crossing the State of New Jersey. There, alongside the Delaware River, hemmed in by a high mountain ridge, is Pahaquarry Township of Warren County. By-passed by modern life with its hubbub, it remains much as it was when the Indians roamed there. Paradoxically, it was one of the first areas settled by the Dutch of the New Netherlands who were drawn to the region in search of minerals. Some of them tarried to establish farms and lived in solitude for seven decades before the vanguard of British colonists penetrated the retreat. Although the picturesque spot shown on our cover is only two minutes' walk from the road, it is unseen by most of the casual motorists who stray into the section.

●

IN THIS ISSUE

ACCORDING to T.A. Rickard's authoritative *History of American Mining*, the earliest authenticated discovery of copper ore on the mainland of North America was made in Massachusetts in 1632. The deposit was not worked at that time, however, and the first production of copper on record is attributed to a company that was chartered in 1709 to open a mine in Connecticut. But perhaps there was a much earlier copper-mining venture in New Jersey. Our leading article presents the known facts and does considerable surmising. That is as far as we can go. Draw your own conclusions.

●

A LEAKY automobile tire is repaired at once, through necessity, but leaky compressed-air lines, connections, and appliances are often ignored for days, weeks, or even months. Managements of many industrial plants would be startled if they knew how much money escaping air costs them annually. Inefficient use of air power likewise is wasteful and extravagant. A thorough survey, followed by corrective measures and a sound, sustained maintenance program may prove profitable. Page 65.

●

IRONING shirts in a modern laundry is no longer the tedious task of yore. The job, divided into several operations, is performed in jig time by ingenious machines actuated largely by compressed air. Page 68.

●

THE heading on page 70 is not wrong. Rocks are broken with feathers, but they are steel feathers. The method described and illustrated goes back farther than written history.

●

THE study of Mars has long been a hobby of James R. Randolph (Major, Honorary Reserve, U.S. Army) who wrote his first published article about the planet in 1928. He is a former editor of *The Journal of the American Rocket Society*. His contribution (page 72) explains, rather logically, that the so-called "canals" of Mars are probably not waterways at all.

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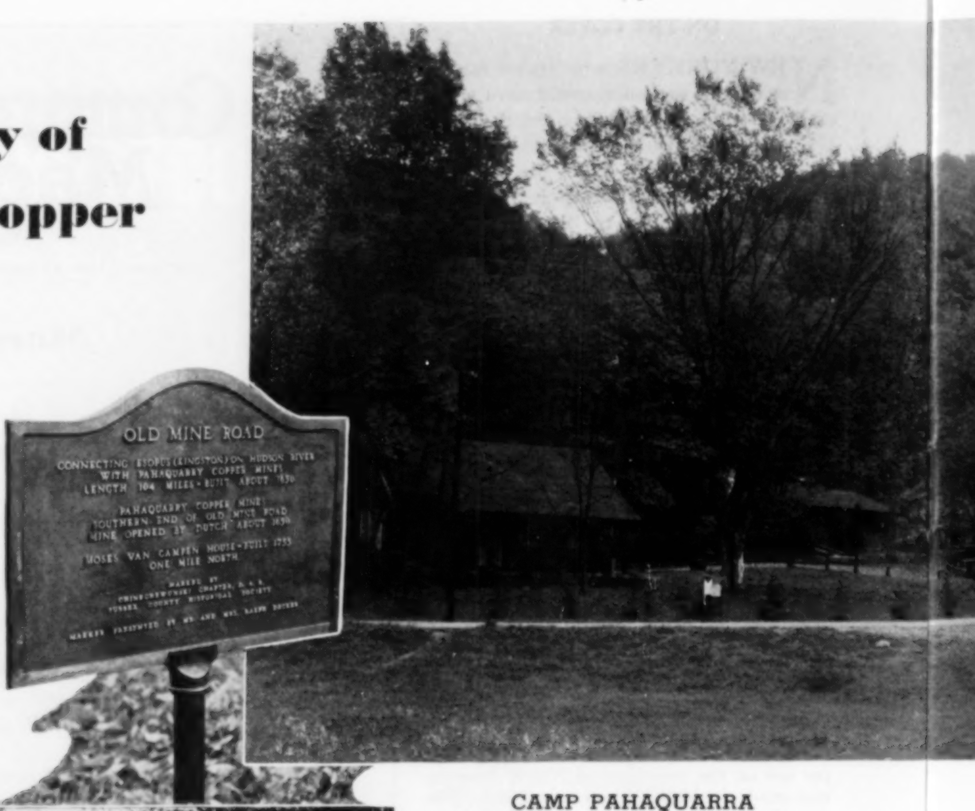
The Mystery of Pahaquarry Copper

Mingled Facts and Conjecture Indicate that Dutch Worked Mines in Secluded New Jersey Valley Around 1650

C. H. Vivian


OLD MINE ROAD
CONNECTING ESOPUS (KINGSTON) ON HUDSON RIVER
WITH PAHAQUARRY COPPER MINES
LENGTH 104 MILES - BUILT ABOUT 1650
PAHAQUARRY COPPER MINES
SOUTHERN END OF OLD MINE ROAD
MINE OPENED BY DUTCH ABOUT 1650
MOSES VAN CAMPEN HOUSE - BUILT 1755
ONE MILE NORTH

CAMP PAHAQUARRA

The copper deposits, apparently discovered by the Dutch 300 years ago, are now owned by the Boy Scouts who converted for their use some of the buildings left by latter-day operators who failed in an effort to work the minerals profitably. The bronze marker shown is on the grounds.

STRETCH OF OLD ROAD

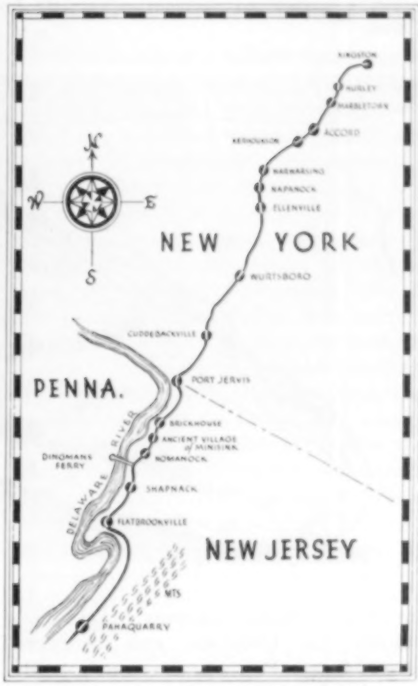
This section, south of the hamlet of Millbrook, N. J., is probably little different today than when it was built. Connecting links at both ends have been widened and black-topped and some changes made in grade and alignment. Woodrow Wilson, when he was governor of New Jersey, suggested constructing a Delaware River drive along the stream from Cape May to the northern extremity of the state, and the proposal has recently been revived. If it is carried through, Pahaquarry Township will lose some of its tranquillity.

DID the Dutch operate a copper mine in a secluded mountain nook of New Jersey 300 years ago, a full century and more before the Lake Superior deposits were opened up? Permanent bronze markers, erected by an accredited historical society, declare that they did, but the lapse of time has made it difficult to substantiate the claim. Legends handed down through generations constitute the principal evidence now in hand, for documentary proof is not to be found. Old records show, however, that copper specimens were sent back to Holland by those early settlers. Local historians, from the earliest to the latest, have accepted the accounts that active mining was done, and even official technical reports have perpetuated them.

The stories are based partly on incontestable facts and partly on surmise. Here are the facts: Along the Delaware River and in the northwestern corner of New Jersey, less than an hour's drive from the offices of this magazine, are old workings obscured for the most part by the ravages of time and weather. But there is at least one adit in such good condition that it can still be entered. The steeply tilted sandstone rocks are impregnated with copper-bearing minerals from which samples that assay up to 3.25 percent in metallic content are readily

ROUTE OF ROAD

This sketch, taken from Mrs. Amelia Stickney Decker's book, "That Ancient Trail," shows the present course of the highway, which has been changed but little through the years. The New Jersey section, extending 45 miles from Pahaquarry to Port Jervis, N.Y., has no route number. From Port Jervis to Kingston it is U.S. 209. South of Pahaquarry the road runs to Columbia, N.J.



obtainable. In 1860, and again in 1868, the possibility of mining the deposit was investigated, but no ore was extracted. At the beginning of 1901 work was undertaken and carried on intermittently for thirteen years. Men identified with those operations are still living and state that some of the openings were in existence when they first viewed the scene and that all they did in some instances was to clean them out and explore them.

It is certain, then, that considerable mining had been done there at some earlier date. There are ample records of kindred activities in the state after the British acquired control of the territory in 1664, but they contain no mention of operations in this section other than those just cited. Furthermore, several responsible persons who visited the area prior to 1800 left writings indicating that even then the "mine holes" were well grown over and caved. It must be inferred, therefore, that the Dutch who preceded the English were responsible for the original workings.

Another unquestioned fact is that a road, 104 miles long, extending from Esopus—now Kingston—on the Hudson River to the vicinity of the mines was built during the period of Dutch occupation. It was a stupendous project for those times, because the whole route was covered with forests and much of the terrain is uneven and rocky, to say the least. That road was not needed for the pursuit of farming and fur trading. The logical explanation is that it was constructed to haul the ore or concentrates to the Hudson for transshipment to Holland.

That is as far as the known facts go. There is no record of substantial consignments of ore or concentrates to the motherland; no written account of how the road was built and financed, of how the ore was extracted and treated prior to being exported. The tools and equipment required for mining and concentrating the ore and for carving out the route could not have been manufactured in this country, they must have been procured abroad. But there is no mention of any of these things in the piles of official documents and letters that deal with the days of Dutch rule. Consequently, much is left to conjecture, and there are many gaps in the chronicle. However, one of the best reasons for accepting it, fact and surmise alike, is that nothing has been unearthed that would tend to disprove it. Many interested persons, some of them descendants of the early Dutch settlers, have spent years trying to piece out the story, and others are now engaged in research with that in view. Such additional fragmentary information as comes to light from time to time seems to support rather than discount the traditional explanation.

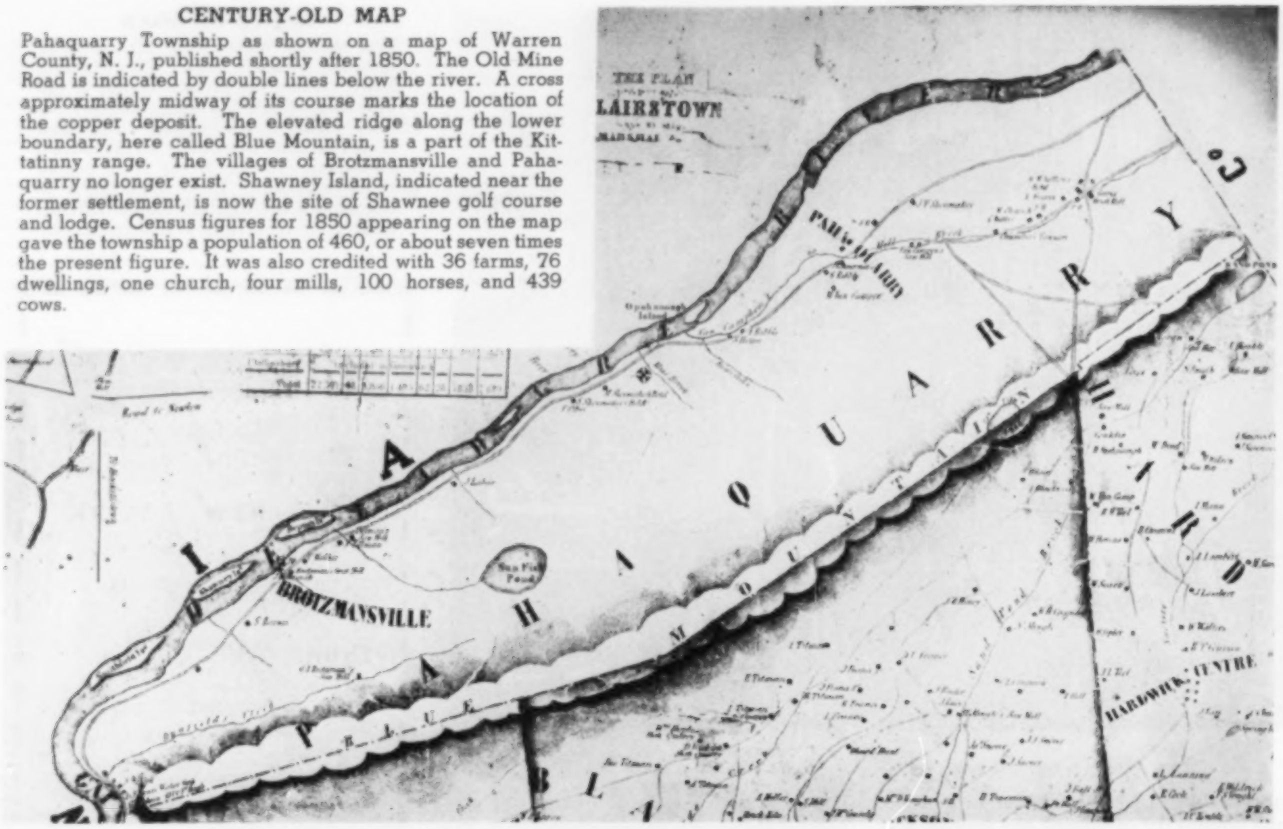
The copper deposit is located in Pahaquarry Township of Warren County, approximately 50 air miles west of New York City. The elongated township borders the Delaware River for a distance of 12 miles and has an average width of 1½ miles. Along the waterway there is a narrow strip of sometimes fairly level land that varies from a few hundred feet to half a mile wide. Eastward of it the ground slopes upward precipitously, culminating in a mountain ridge that reaches an elevation of 1500-1600 feet, or to a height some 1200 feet above the river.

Guarded as it is by the Kittatinny range—a spur of the Appalachians—and containing relatively little land suitable for farming, the section has remained substantially in its primeval state. It is the most secluded and wildest township in New Jersey, and the most sparsely populated. In it is a single small village, Millbrook, which is not large enough to support a post office, and all its residents receive mail by rural carrier. Although the greatest concentration of human beings in the nation is only 90 minutes' driving time away from it, few of these millions have ever penetrated this mountain fastness. A few nature lovers have learned of its scenic grandeur and isolation, and there is a sprinkling of summer cottages, one tourist camp, and two Boy Scout camps in the area. Even in the summertime one can normally motor the length of the township without meeting more than half a dozen cars, and it is unusual not to see deer. Some 4500 acres is leased by a hunting club.

Across the river, in Pennsylvania, conditions are much different. The valley widens out on that side, and the abundant acreage of level land is checkerboarded by cultivated fields. A heavily

CENTURY-OLD MAP

Pahaquarry Township as shown on a map of Warren County, N. J., published shortly after 1850. The Old Mine Road is indicated by double lines below the river. A cross approximately midway of its course marks the location of the copper deposit. The elevated ridge along the lower boundary, here called Blue Mountain, is a part of the Kittatinny range. The villages of Brotzmansville and Pahaquarry no longer exist. Shawney Island, indicated near the former settlement, is now the site of Shawnee golf course and lodge. Census figures for 1850 appearing on the map gave the township a population of 460, or about seven times the present figure. It was also credited with 36 farms, 76 dwellings, one church, four mills, 100 horses, and 439 cows.



traveled concrete highway, U.S. 209, follows the Delaware and connects Stroudsburg, Pa., on the south, with Port Jervis, N.Y., on the north. Downstream, only 6 miles from a point opposite the copper deposit, is Shawnee with its well-known golf course and lodge owned by orchestra leader Fred Waring. Westward are the Pocono Mountains, summer playground of thousands of persons.

But the river effectively separates Pahaquarry Township from all this activity and flow of humanity. The nearest crossings are 12 miles downstream from the old mine by way of a covered bridge between Columbia, N.J., and Portland, Pa., and 19 miles upstream at Dingman's Ferry. Only one road, at the northern end of the township, leads eastward over the mountains, but it is so steep and rough that most motorists shun it. There are no indications that anything will happen in the foreseeable future to alter the status of this narrow, rock-ribbed domain where life has never felt the hectic touch.

At the time the Dutch first saw the region it was the home of the Leni-Lenape Indians, members of the Algonquian tribe. They inhabited the Delaware Valley throughout its length, and for that reason were known to the white man as the Delawares. The Minsis occupied this northern section. Both sides of the river, for a matter of 40 miles or so south of where Port Jervis now stands, were called Minisink by the Indians. The word means "where the waters have gone," and, according to a tribal legend, a vast lake covered all that area in years long gone. That may well have been true. Eight miles below the copper showing, the Kittatinny Ridge bears westward and crosses the river. There the stream flows through a V-shaped opening, Delaware Water Gap, that has been hailed as one of the natural wonders of the East. There was a time, perhaps, before the barrier was breached when it backed the water up for many miles.

Some of the Dutch colonizers who crossed the Atlantic to the New Netherlands worked their way up the Hudson. Although the British claimed otherwise, it is fairly well established that they reached the present site of Kingston in 1614 and built a small fort there at the mouth of the Roundout River. Gradually they increased in number until there were 60 or 70. They apparently got along well with the Indians and lived on their various farms without fear until someone made the mistake of trading brandy for the red man's peltries. Gradually relations grew worse, and in 1658 a stockade was erected at the direction of Gov. Peter Stuyvesant from his seat of government in New Amsterdam, now New York City. Prior to that time the community had grown, and in 1651 it was given a municipal charter and named Wiltwyck. For years, however, it had been generally known as Esopus, and it remained so until the British took it over in 1664 and renamed it Kingston.

Most of the early settlers expected, or at least hoped, that they would find valuable minerals in their adopted land, and prospecting was an auxiliary activity of many of them. Farmers watched for promising-looking rocks as they plowed their fields, and traders asked all whom they met if they had seen signs of mineralization. Evidence that officials in Holland were similarly minded is found in a letter received in December, 1645, by William Kieft, director-general of the West India Company, instructing him to "turn attention to the mineral wealth of the province." It was only natural, then, that the Dutch pioneers at Esopus should spend some of their spare time exploring the surrounding country, gradually going farther and farther from their homes.

As the story of the Pahaquarry copper mine has been reconstructed, parties made their way up the Roundout Valley along trails used by the Indians and were rewarded by finding a lead deposit near the present site of Ellenville, about 50 miles from the Hudson. Thus encouraged, they pressed onward over the uplands that divide the Hudson and Delaware watersheds, and then followed the Neversink down to its confluence with the Delaware near Mahackameck where Port Jervis now stands. Proceeding along the main stream, they eventually discovered green-stained rocks that betokened copper and began mining. As previously stated, the road was built to provide a haulageway to the Hudson.

Although New Amsterdam was much closer than Esopus, the Dutch had no way of knowing that. To reach it, they would have had to cross the high mountains, whereas the route selected offered a water grade all the way.

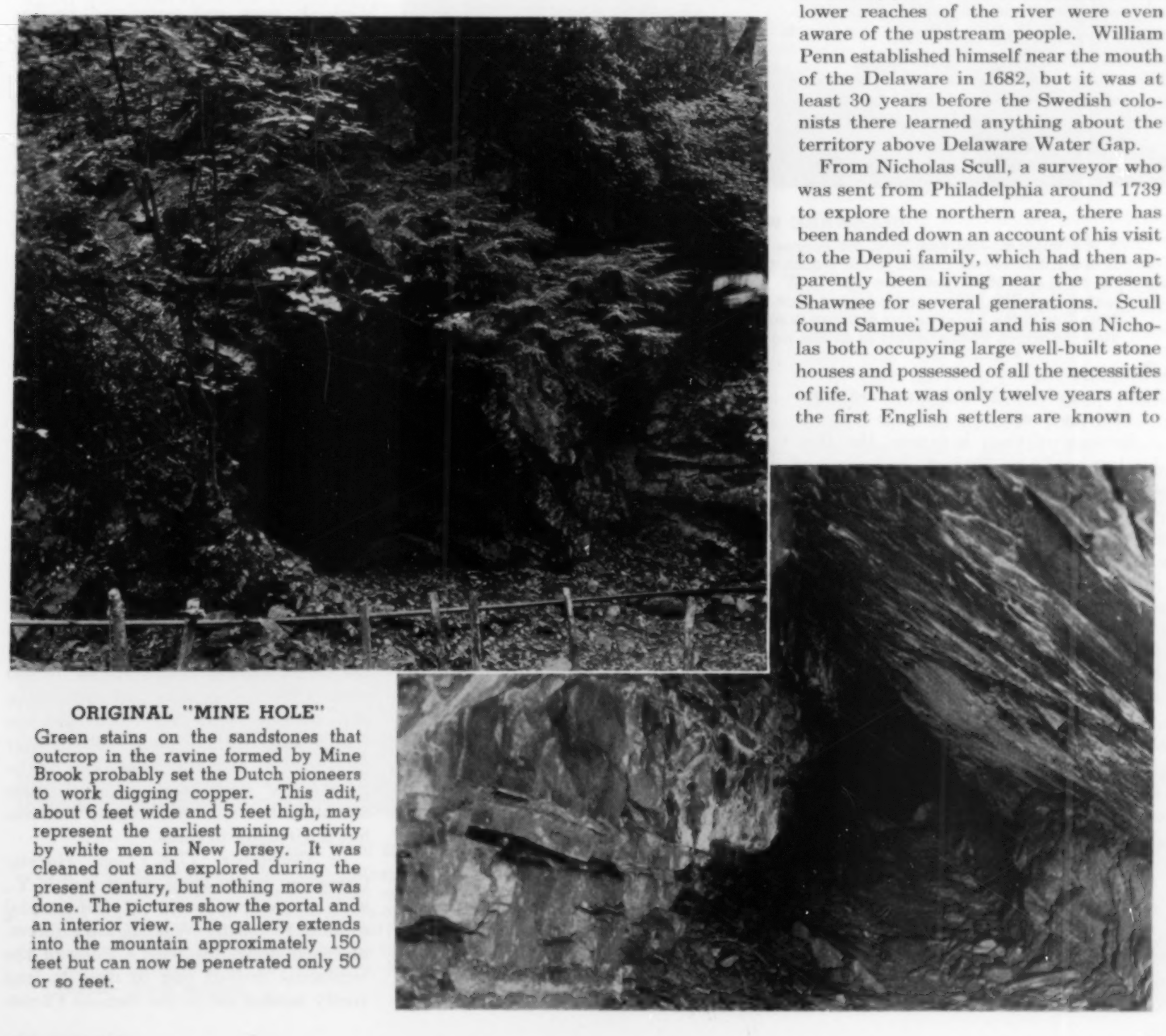
Markers placed along the road several years ago by the Chinkchewunski Chapter of the D.A.R. and the Sussex County Historical Society fix the beginning of its construction and of mining at "about 1650," although other sources of information incline towards a later date, with 1659 most favored. It seems likely that operations ceased when the British obtained control in 1664. The workings, in their present state, give little indication of how long mining might have been in progress, especially as it is not known what tools and how great a labor force were available. In all, eighteen openings have been located, but some of them were undoubtedly made by operators in this century.

Several references to the occurrence of minerals in the New Netherlands are found in Holland state papers of the period, but none indicates that mining was actually carried on. One that has been quoted often by historians and other writers is a letter sent in 1657 by the commissioners of the West India Company in Holland to Peter Stuyvesant. It reads: "We lately saw a piece of mineral, said to have been brought from New Netherland, that was such good and pure copper that we deemed it worth inquiring about of one Claes de Ruyter, as we presumed that he must know if the fact is as stated. He asserted that there was a copper mine at Minnisinck; and that between the Manhattans and the South River there had been discovered a mountain of crystal, of which he had brought several specimens with him."

This description fits the Pahaquarry deposit, the Dutch having called the Delaware the South River to distinguish it from the North or Hudson. It can be assumed that de Ruyter carried the specimens mentioned when he went back to Holland for a visit and that he later returned to America, for a letter replying to the one just cited was written in 1659 by the commissioner of the colony near the mouth of the Delaware and told of interviewing de Ruyter. In a book, *That Ancient Trail*, published in 1942, Mrs. Amelia Stickney Decker, of Sussex, N.J., whose forebears were among the earliest Dutch settlers in the section under discussion, states: "It is claimed that some of the copper taken from these mine holes by de Ruyter in 1657 may be seen today in Holland's National Museum."

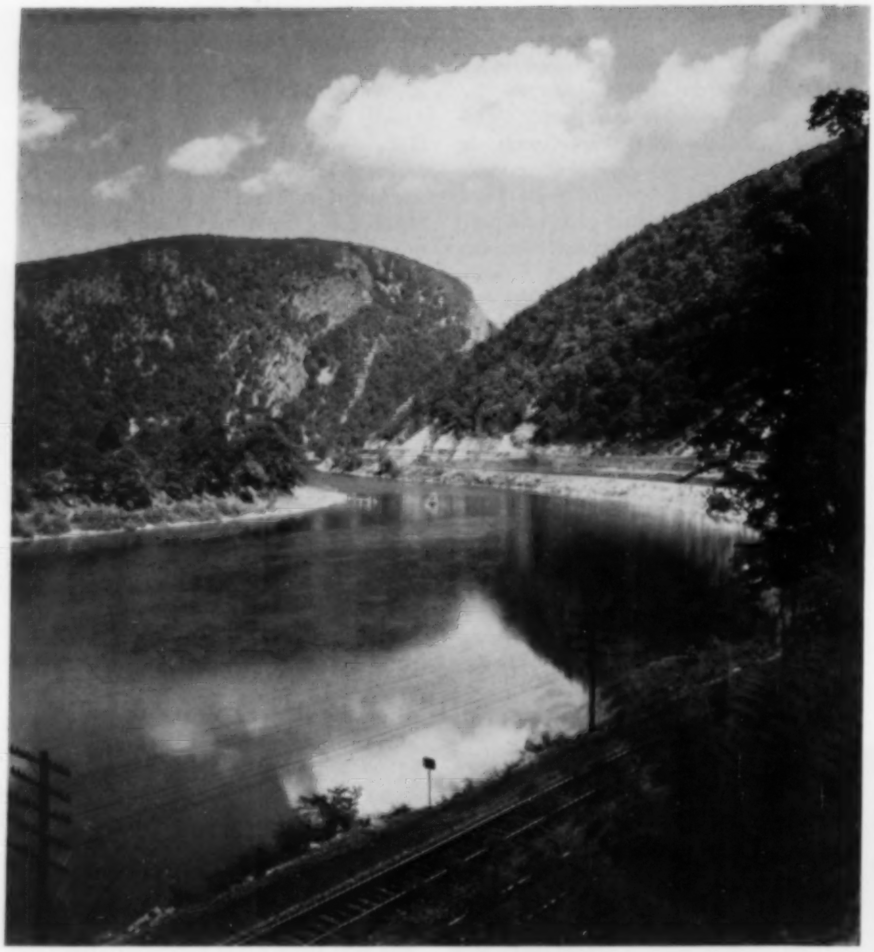
There is reason to believe that some of the Pahaquarry miners, and perhaps others who worked their way down the old road, remained as permanent residents. A number of them probably stayed on the New Jersey side of the river, but most of them forded it near the mine site and took up their homes on the Pennsylvania side where conditions were more favorable to farming. One of the earliest of the latter was named Depui, which corresponds to the modern Depue. It should be pointed out that those colonists knew nothing about the country downstream from them, and it was many years before the settlers on the lower reaches of the river were even aware of the upstream people. William Penn established himself near the mouth of the Delaware in 1682, but it was at least 30 years before the Swedish colonists there learned anything about the territory above Delaware Water Gap.

From Nicholas Scull, a surveyor who was sent from Philadelphia around 1739 to explore the northern area, there has been handed down an account of his visit to the Depui family, which had then apparently been living near the present Shawnee for several generations. Scull found Samuel Depui and his son Nicholas both occupying large well-built stone houses and possessed of all the necessities of life. That was only twelve years after the first English settlers are known to



ORIGINAL "MINE HOLE"

Green stains on the sandstones that outcrop in the ravine formed by Mine Brook probably set the Dutch pioneers to work digging copper. This adit, about 6 feet wide and 5 feet high, may represent the earliest mining activity by white men in New Jersey. It was cleaned out and explored during the present century, but nothing more was done. The pictures show the portal and an interior view. The gallery extends into the mountain approximately 150 feet but can now be penetrated only 50 or so feet.



DELAWARE WATER GAP

A few miles downstream from the copper deposit the Delaware River has carved in the Kittatinny mountain range a gash that is 1600 feet high, 900 feet wide at the base and 4500 feet at the top. L. W. Brodhead, an early local historian, estimated that 8½ billion cubic feet of rock was moved to create the opening. The main line of the Lackawanna Railroad is seen in the foreground of this downstream view, in which Pennsylvania is on the right and New Jersey on the left.

have come down the old mine road as far as Warren County.

Because of their isolation, the Hollanders spoke no English, but some of them knew the Indian language, and Scull was able to converse with them in that tongue. He was particularly impressed with the size of their apple trees, which he described as much larger than any he had every seen around Philadelphia. The Depuis told him that they had heard from older residents of the section that the Dutch had opened the mines and built the road. It was their understanding that they were "very great or rich people, as much labor was expended on the projects." Even at the time of Scull's visit, the Depuis and their neighbors were using the road regularly to haul wheat and cider to Kingston, where they obtained "salt and other necessities." They took their produce northward because there were no routes leading to the south, and stretches of the Delaware were not navigable because of rifts or rapids.

Nicholas Depui, in fact, is credited with having opened a channel through Foul Rift that enabled the settlers to go downstream some 30 miles to Easton, Pa., but even then it was such a hazardous journey that they usually chose the road to Kingston. Those trips were made in winter, when the river could be crossed on the ice. In after years, Dimmick's Ferry provided a crossing 3 miles below the mine site. It was subsequently moved upstream a few miles and finally abandoned about twenty years ago after having operated 150 years or more.

Regardless of the uncertainty that clouds the early history of the Pahaquarry mines, there can be no doubt that the road which served them was the first thoroughfare of any consequence in the nation. Even 100 years after it was constructed it was still the longest colonial highway and in the same good condition as before, suggesting that it had been traveled sufficiently in the meantime to keep it open and supporting the contention that many Dutch colonists continued to live along its borders even after the mines were shut down. That theory is bolstered by a recorded decrease of population in the Kingston area between 1658 and 1663. Many of those that left perhaps took up new abodes along the main travelway.

Archives of New York State reveal that between 1704 and 1734 the general assembly received several petitions from Jacobus Swartwout and others in Orange and Ulster counties asking for assistance in repairing the road because they and their neighbors had no other route for transporting their produce. By 1704 there were "Yaugh Houses" or resting places at various points along the way used by both whites and Indians while on hunting expeditions. A plat of a village called Minisink made in 1725 shows ground allotted to the Westbrooks, Cortrights, VanKuykendalls, and Westfalls —all Hollanders.

That settlement, of which little trace remains today, was situated about 16 miles downstream from Port Jervis and adjacent to an Indian village of the same name. Nearby was one of the largest burial grounds of the Minsi tribe. Two islands in the river, called Big and Little Minisink, were well populated by Indians. There was the starting point of one of their principal trails, which lead through a gap in the mountains to the east and thence across New Jersey to the seashore. It was traveled regularly to obtain shellfish, which were dried and then carried back to headquarters on the Delaware. Large mounds of shells found by early white settlers at various places along the coast, notably at Tuckerton and Barnegat, indicated that the practice had been followed for generations.

Upwards of 50 houses ranging in age from 100 to more than 200 years are still standing along the New Jersey section of the old road, most of them in Sussex County. Practically all are of stone, and in several instances their recent and present owners have been careful in modernizing them to preserve as much as possible of the original structures.

On several occasions the road figured prominently in national history. During the French and Indian Wars, 1755-63, there were many uprisings and massacres by the Minsis in this stretch of the Delaware Valley. The situation became so bad that on December 27, 1755, the provincial council appropriated 10,000 pounds for the erection and garrisoning of forts. Equivalent to $50,000, that was a huge sum in those days. Of the four forts built on the New Jersey side of the river, only Fort Nomanock, 6 miles downstream from Montague, remains but is virtually in ruins.

In December, 1776, Gen. Horatio Gates, en route from Saratoga, N.Y., with seven regiments of Continental soldiers to bolster Washington's forces, marched down the road. Four of the regiments arrived just in time to lend sorely needed aid in the famous Christ-

ISAAC VAN CAMPEN INN

This limestone house, 15 miles south of Montague, N. J., dates from 1750 and was conducted as an inn for many years, John Adams having been among its guests. The interior has been preserved essentially in its original condition. The heavy timber beams were hand-hewn and polished as smooth as glass. Floor boards are 12 inches wide and joined with thin lath-like strips that serve the same purpose as modern tongue-and-groove construction. The stairway balustrade is of black walnut, with hand-turned balusters. The windows still retain some of the original glass panes that were imported from England. John DeWitt, who acquired the property in 1829, is reported to have owned the last slave in Sussex County.

mas-night crossing of the Delaware that turned the tide of the Revolutionary War in favor of the colonists. That backwoods route was chosen to keep the British ignorant of the reinforcements. In 1777, Robert Erskine, surveyor-general for Washington, surveyed the road, and shortly thereafter it appeared on maps for the first time.

Between 1774 and 1778, John Adams used the road in traveling on horseback between his Massachusetts home and sessions of the Continental Congress in Philadelphia. It was his custom to stay overnight at Isaac Van Campen's Inn, which is illustrated and described at the right. Nearby is an old burial ground. Among the bodies interred there is that of Mrs. Anna Symmes, one of whose daughters was married in 1795 to William Henry Harrison, ninth president of the United States.

It is a curious fact that Pahaquarry Township has fewer residents and less activity today than it had 100 years ago. It was organized in 1825, a year after Warren County was created by dividing Sussex, and was first called Packaquarry, which was taken from the Indian name Pahaquakong. The settlers soon established gristmills and sawmills to serve their needs, but none is to be found today. As early as 1835 a factory for making school slates from material from a nearby deposit was operated in its extreme southern end. At one time the plant employed 50 persons, but it was closed many years ago. Towns such as Brotzmansville, Browntown, and Calno, which once had post offices, are no longer in existence, although there is a school at Calno. In 1880, the township population was 418; in 1950, it numbered 67.

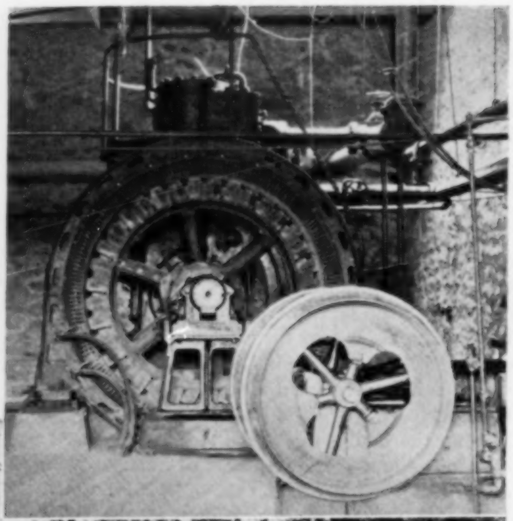
The one serious attempt made to work the copper deposit in recent times ended in failure after considerable money had been spent. The revival effort was one phase of a state-wide copper-mining boom at the beginning of the present century, when companies were formed for the purpose of reopening most of the 20-odd New Jersey deposits that had been located by pioneer prospectors. However, only one, the Schuyler near Newark, ever experienced a profitable period of production. Some of the activities were primarily stock-selling schemes, but the Pahaquarry promoters did a lot of work and apparently had a conscientious but erroneous conviction that they could make the venture pay.

In 1901 the Montgomery Gold Leaf Mining Company bought from Philip Godley, of Philadelphia, 1602 acres of land that included the old Dutch workings. After considerable prospecting, some new tunnels were driven, at least two shallow shafts sunk, and a quarry that was intended to be the main source of ore supply was opened at a location several hundred feet up the mountainside. From the mill site at the base of the slope, where water was available from a small stream called Mine Brook, an inclined railroad was built to the open pit for transporting ore. This operated on the funicular principle; that is, a loaded descending car pulled up an empty one by means of a connecting cable running over a sheave wheel at the top of the incline. Four electrically powered rock drills were used in the quarry for putting in blast holes, but their tendency to break down slowed up production.

A milling plant with a rated daily capacity of 200 tons, a 1000-ton ore bin, a boardinghouse, powerhouse, and other structures were erected and equipped.

MOSES VAN CAMPEN HOME

In 1732, Abraham Van Campen reportedly bought the northern half of what is now Pahaquarry Township. His son Moses, who served as a colonel during the French and Indian War, built the home shown here in 1755 at a point a mile north of the copper deposit. Its stone walls are 2 feet thick. In the basement were slave quarters and stalls for small mules used on the farm. In a nearby cemetery are graves of several generations of Van Campens, Ribbles, Depues, Shoemakers, and other pioneer Dutch setttlers.



MEMENTOS OF FAILURE

Perhaps as much as half a million dollars was expended between 1901 and 1914 in a vain effort to develop a profitable process for extracting copper from the Pahaquarry ore. In the view directly above, taken recently, are seen the foundation on which the mill buildings stood. Power was supplied by a gas engine-driven generator, which is illustrated at the upper-right. The old picture at the upper-left shows a section of the funicular railroad that was built to haul ore to the mill from an open pit high up on the mountain slope.

As no electric lines ran near the property, a gas producer was installed to provide fuel for a Weber 3-cylinder gas engine that drove a 722-kva. generator. The roads were not good enough for hauling the heavy generator the 9 miles from the closest railroad delivery point in the conventional way, so it was moved the entire distance with block-and-tackle rigging, for which mules supplied the energy. Delivery of anthracite coal for the producer also created a problem, and much of it was brought in on sleds in the wintertime.

The milling process first used, said to have been successful in Germany and patented in this country by Dr. N.S. Keith, the company's metallurgist, was being tried out at the same time at the Schuyler Mine It involved crushing and grinding the ore to a powder, then roasting and treating it with dilute sulphuric acid. The latter was supposed to dissolve the copper, which was then to be recovered as metal by electrolyzing the solution.

Preparations for production were halted temporarily by a lack of funds, but in 1906 the concern, reorganized as the Pahaquarry Copper Company, announced that it was ready to test the method. In 1908 the officials admitted that the treatment and the equipment would have to be "materially altered." After the changes had been made and a new water pumping station built, the mine and mill were operated for two or three months in 1911, but no concentrates were shipped. The Keith process was then abandoned, and four conventional concentrating tables were set up. These yielded some concentrates which were transported to the Nicholas smelter on Long Island, N. Y.

Further experimenting was undertaken in an effort to put the mine on a profitable basis, but before anything came of it the company went into receivership and ultimately passed into the hands of a concern headed by Godley, the former land owner. Attempts to interest a British group that represented the Lockwood process for extracting copper failed, and most of the buildings were eventually dismantled and the workings abandoned. Some years later the property was included in a purchase of 1500 acres by the Mercer, Warren, and Hunterdon County Boy Scouts for use as a summer camp. Headquarters are at the old mill site, and two of the old structures were converted for occupancy. The machinery that remained was broken up and sold as junk.

The geology of the Pahaquarry deposit is described in *Copper Mines and Mining in New Jersey*, prepared in 1944 for the Department of Conservation and Development, State of New Jersey, by Herbert P. Woodward, then professor of geology at the University of Newark. The principal mineral is chalcocite, or copper sulphide. But instead of occurring in fissure veins it is disseminated throughout a sandstone formation that was apparently laid down in fresh water and not in the open ocean.

The layers that carry the ore are from 2 to 6 feet thick and are separated by bands of red shale. The extreme thickness of the ore-bearing horizon is given as 200 feet, and portions of it have been traced on the surface for 2000 feet. According to Professor Woodward, the aggregate amount of mineral present is considerable, but its low grade and the uncertainty as to whether it can be effectively and economically recovered put the deposit in the doubtful class. "It must be strongly suspected," he states, "that this is not a deposit of commercial value or potential economic significance; yet such a suspicion has not been proven beyond shadow of doubt."

Small Air Leaks Can Be Costly

Thorough Survey of Plant Distribution Lines and Regular Maintenance Will Pay Off

THE importance of trifles has been expounded in many ways. In industry, leaks in compressed-air systems, trivial in most individual cases, are responsible, in the aggregate, for huge wastage. Costly energy that could have done useful work escapes through tiny openings—a direct monetary loss. Moreover, it takes only a few of these hissing leaks to reduce the line pressure sufficiently to affect the efficiency of air-driven tools and machines. This slows down operations, and time is money. It is difficult to evaluate these indirect losses in terms of dollars and cents, but they unquestionably add up to a large sum.

The bigger the plant, the greater the potential loss because more air is used, distribution lines are longer, and there are more outlets and connections that can become leaky. Manufacturers of air-producing and air-consuming equipment, conscious of the fact that air power has competitors and will, broadly speaking, hold its own only if profitable, have long advocated regular maintenance to curb escaping air. Such a course is but one manifestation of good industrial housekeeping, which has been gaining steadily in popularity and paying off as labor costs have continued to rise. Some of our largest concerns are now the most scrupulous chasers of wasted production pennies.

To illustrate: The publication *Automobile Facts*, sponsored by the gigantic motor-car industry, recently reported that one firm alone has 96 technical committees sleuthing around to see where operating dollars can be stretched. Ideas are tried out in one plant and, if found worth while, are then introduced in others. In an effort to reduce compressed-air losses, a program of air-valve replacement and removal of unnecessary piping was progressively instituted according to this formula. As a result, the company saved as much as $100,000 in 1949.

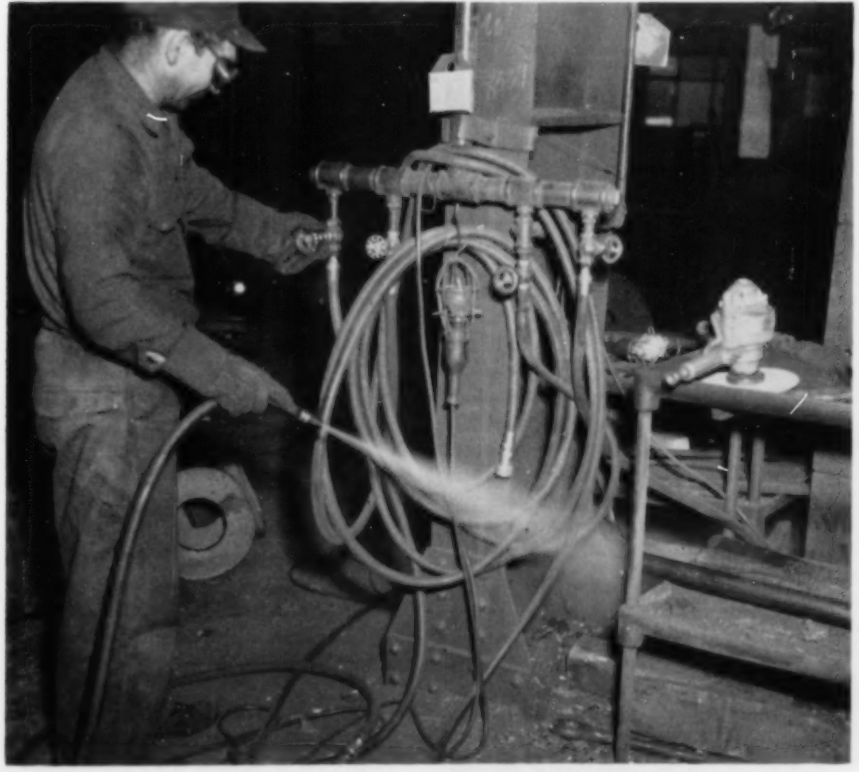
COSTLY VALET SERVICE

Using compressed air for purposes such as this can be dangerous, and it is certainly wasteful. It is frowned upon by the safety departments of industrial concerns, but the practice is hard to stamp out.

Even more spectacular is the estimate of potential economies in all divisions of General Motors Corporation through the application of conservation measures to all compressed-air systems. According to William J. O'Connell, process engineer in the Moraine Products Division, the General Motors Plant Engineers Subcommittee on Utilities places the expected return from this campaign at one million dollars. This statement appeared in an article in *Plant Engineering* outlining the results of a survey of the compressed-air facilities in the Moraine factories. Because the information presented may be of practical value to many of our readers, an abstract of the article follows.

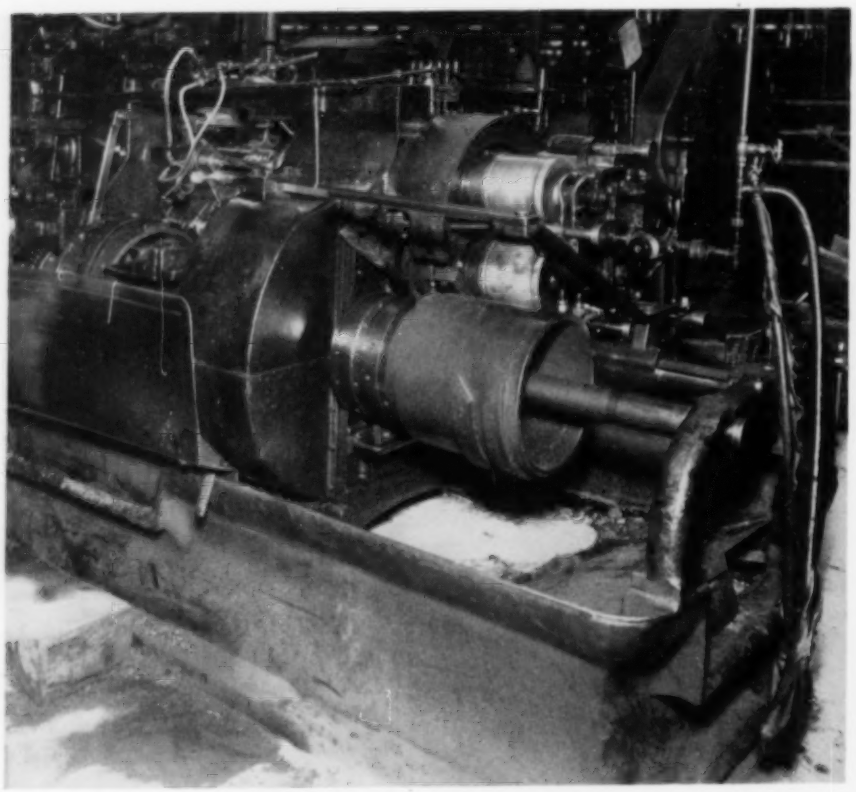
Compressed air, it is pointed out, can be expensive if it is misused or wasted, but when properly used in the right places it is economical and efficient. Unlike water, it cannot be seen; unlike gas, it isn't dangerous. But, like both of these utilities, it costs money. In industrial plants it serves, among other ways, as a source of power, a parts ejector, a chip remover, and as a drying, cleaning, and cooling agent. Constant vigilance is necessary to assure proper, economical use and to guard against excessive leakage.

Thorough familiarity with a compressed-air system—with its applications and misuses—is necessary before intelligent action can be taken to improve it.



BLOWING MOISTURE FROM LINE

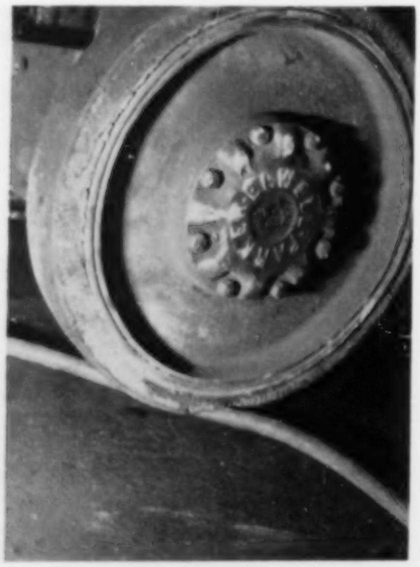
The foundry worker who is wasting air by blowing condensed moisture from the line before connecting it to a tool should not be condemned. Management can prevent this sort of wastage by providing aftercoolers for compressors and placing separators at strategic points in the air-distribution system.



DESERVING OF RETIREMENT
The hose hanging at the right end of this machine tool delivers air to a blowgun that removes chips and performs miscellaneous cleaning services. It is mounted in such a manner that it is dragged on the floor and around the corner of the machine every time it is used. The appearance of the hose is in itself an indictment of the arrangement. The piping to which the line is attached conveys air to a pneumatic chuck on the multiple-spindle machine. Regular maintenance of the packing is required to prevent leakage.

Only a systematic survey will provide this knowledge and reveal the network's shortcomings and defects. Then, when these have been corrected, the resultant savings will generally far exceed the cost of the survey. In the plant concerned, it was conducted entirely by observation. To learn where air was being misapplied or wasted, each department was studied individually. Notes and comments pertaining to the various locations examined were recorded on a layout print of the air-distribution system. In the factory are four centrally located compressors which supply a maximum of approximately 4300 cubic feet of free air per minute at 85 psi. pressure. Three of the machines are driven by synchronous motors: two of 200 hp. and one of 250 hp. The fourth is operated by steam at 150 psi. pressure, which is exhausted at 20 psi. and then used for process purposes. The major causes of air wastage were found to be:

1– Air outlets* larger than required for the purposes served.
2– Failure of operators to close outlets* upon completing jobs and leaving stations.
3– Leakage occasioned by defective valves or fittings.
4– Use of air by employees for personal cooling or cleaning purposes.



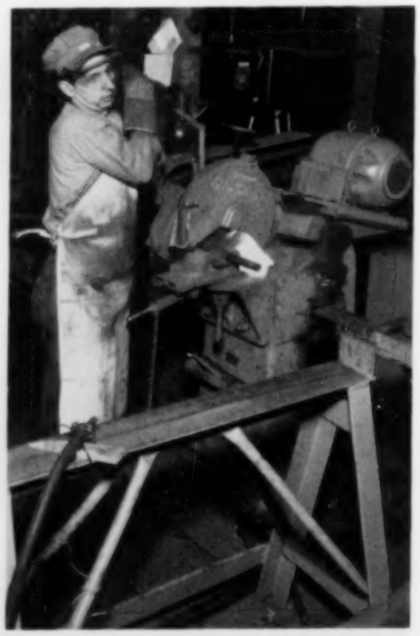
HARD ON HOSE
Air hose is subjected to a lot of punishment even when properly cared for, but abuses such as this unnecessarily hasten the incidence of leaks and consequent wastage of air.

Unnecessarily Large Outlets

Copper tubing, most of it for machine-tool application, ranged from ⅛ to ¼ inch in diameter, the sizes in many instances bearing no relation to the volume of air required for the respective services. Much of the piping had been put in during war years when wanted sizes could not always by obtained. Typical operations were tested to determine what sizes would best meet the needs, and changes were made accordingly. For example, it was learned that a 1/16-inch opening is sufficient to serve a drill where air is used continuously for blowing. For certain press work, where intermittent air blasts kept the die bed clean, a ⅛-inch opening was shown to be the best size.

It was established that a nozzle with a drilled opening of the prescribed diameter should be attached to the end of the tube. Where tubing alone is utilized, machine operators, exercising "an incurable tendency" to try to adjust things to their liking, will use screw drivers, pliers, or any other handy tools to enlarge or contract openings. A drilled nozzle, on the other hand, is relatively tamperproof.

Openings of the correct sizes were provided, but no attempt was made to determine how much air they conserved because there was no way of ascertaining



AUTOMATIC CONTROL NEEDED
To keep sparks and dust away from the operator of this abrasive cutoff wheel in a metalworking shop the air-line nozzle at the lower-left is trained on the machine. The globe valve which controls the flow is located several feet to the right, out of the field of the picture, and the air discharges continually through a ¼-inch opening. This haphazard arrangement could be improved upon in many ways, including some means of shutting off the air automatically when it is not needed.

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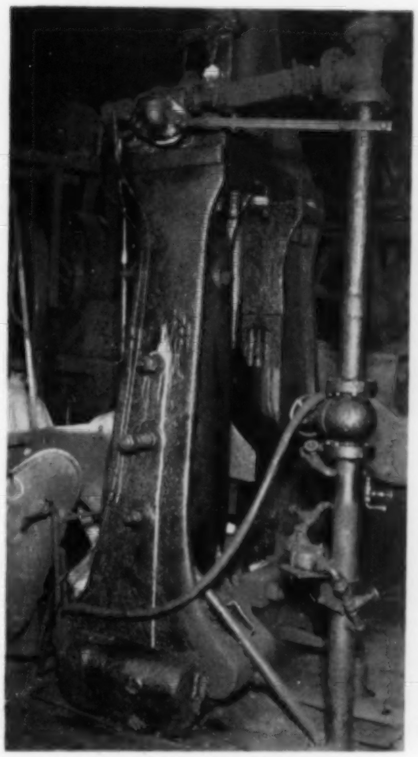
*In the General Motors' plant many machine tools are served by air jets that perform various blowing operations. The term "outlet" as used here refers to jets of this kind and not to the conventional valved connections for hose delivering air to tools.



EFFECT OF VIBRATION

Copper tubing running up the side of this forging hammer carries compressed air to the control valve at the top. The intense vibration of the heavy hammer usually causes new tubing to become leaky after a few weeks of service. Because escaping air is not heard above the shop noises, repairs are generally not made until the pressure drops so low that the valve fails to function.

what the consumption had been before the change. It is evident, however, that material savings were effected, because a $\frac{1}{4}$-inch opening will discharge as much as 90 cfm. of free air at 85 psi., as against 22.6 cfm. through a $\frac{1}{8}$-inch orifice and only 5.64 cfm. through one $\frac{1}{16}$ inch in size.

Air Inlets Left Open

In cases where continuous blowing is required and where the air supply is controlled by a manually actuated valve, the operator will often forget to close the latter when leaving his machine. Applications of this type include air drying, drill or tool-bit cooling, and removal of chips. This situation was corrected by eliminating the human factor—by installing automatic shutoff devices provided with valves controlled either by solenoids or electric eyes.

Leaky Valves, Valve Stems, Etc.

Because operating noises drown out the sound of escaping air, the search for leaky valves and fittings was conducted week ends. An average of one leak per machine was found in departments where air is used as a prime mover for drilling and broaching heads. Leaks in other departments were at least as common. They varied from scarcely noticeable to loud hisses that could be heard many feet away. Because leakage of this sort is continuous, night and day, the cumulative loss is great.

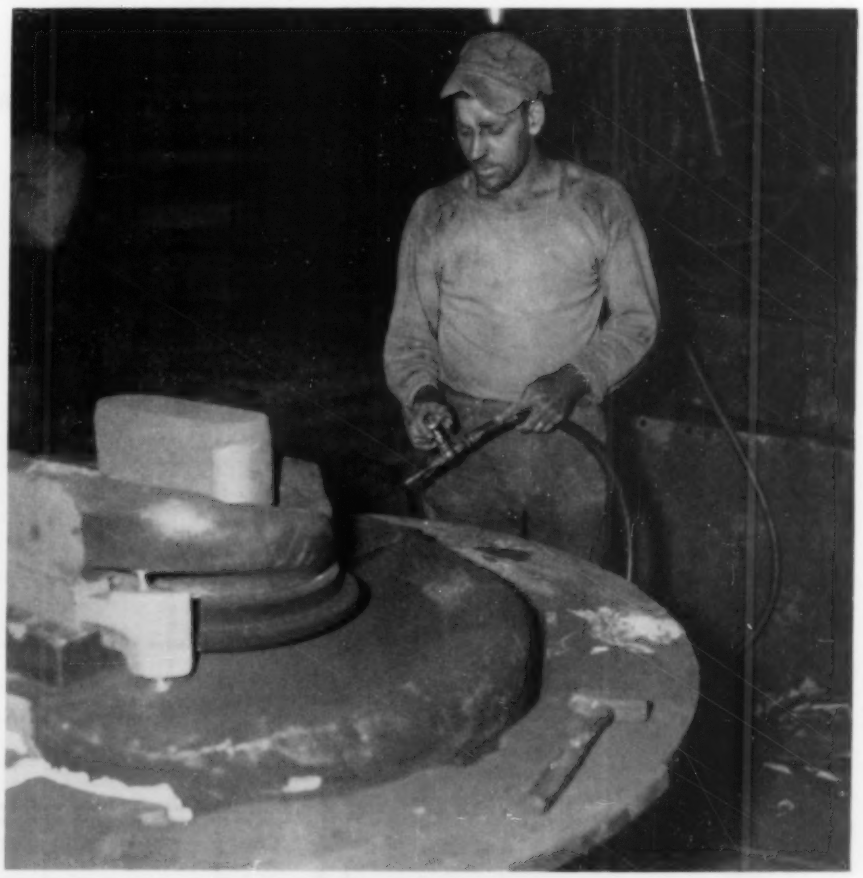
Correction of the condition was turned over to the maintenance department, which made the needed repairs and then instructed a plumber to spend a stipulated part of his day looking for and stopping newly developed leaks. It was discovered that sloppy installation work, rather than natural deterioration, was responsible for many leaks. Consequently, the plumber is now required to test each joint after assembly with a liquid-soap solution, and the plumber foreman inspects and approves the finished job.

Personal Use of Air

During warm weather, some of the employees were in the habit of using air liberally to cool themselves. This was considered a serious matter, not alone because it wasted air and affected operations by reducing pressure but also because it constituted a safety hazard. Although the latter aspect of the situation was not the concern of those conducting the survey, they sought the coöperation of the safety authorities in dealing with it.

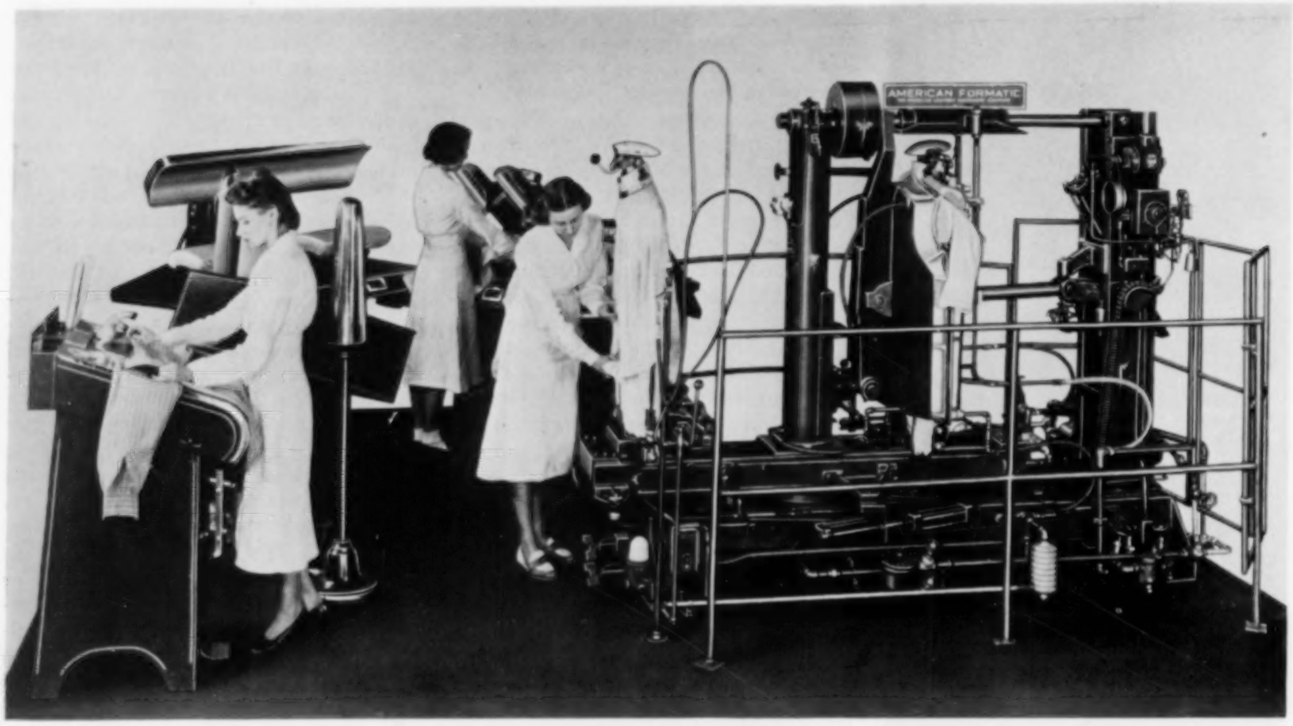
In most cases, a workman cooling himself with a stream of compressed air removed the nozzle, if one was attached, and allowed the air to issue from the larger hose or tube opening, meanwhile controlling the flow by manipulating the main shutoff valve. Assuming an average orifice of $\frac{3}{16}$ inch, each outlet misused in this manner would release about 70 cfm. of free air. Twelve such outlets discharging simultaneously would use up the capacity of one of the plant compressors. This could not fail but reduce the pressure in plant air lines and affect the efficiency of air-operated tools, most of which are designed to function at pressures of 80 to 100 psi.

According to the *Compressed Air Handbook*, a drop in pressure from 90 to 70 psi. will decrease the efficiency of the average portable tool by 37 percent, labor costs at the same time remaining constant. The only practical way in which this wastage can be curtailed or eliminated is by closer supervision of employees, with the enforcement of penalties for this unauthorized use of air. Such supervision in the Moraine plant, tied in with a safety campaign, has reduced this problem to the point where it is of minor proportions. The company intends to stress the safety angle every spring.



MAKESHIFT AIR GUN

Where air is used in foundry blowing services such as this, wastage will be eliminated by equipping lines with trigger-operated guns that close automatically when finger pressure is released.


AMERICAN FORMATIC

NO LOST MOTION

A shirt-pressing and folding unit as set up for smooth-flowing production. From left to right: the folding table served by Operator No. 3; the sleeve forms, sleeve press, and cuff press all in charge of Operator No. 1; and the new Formatic Press—Station No. 2 in the line—which irons the entire body and bosom of a shirt at one time. All the machines are of the pneumatic type and use air at 70 psi. The racks on which the garments are hung are not shown.

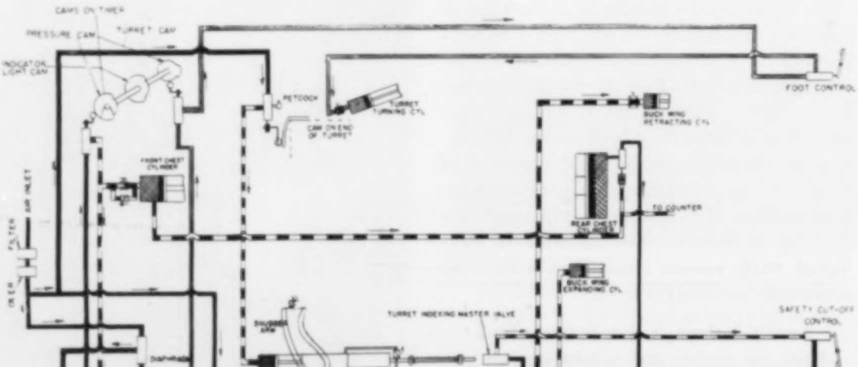
Ironing Shirts by Assembly-Line Method

Anna M. Hoffmann

WITH the new Formatic Press, which irons the entire body and bosom of a shirt in one operation, laundries are reaching a new high in production. This latest piece of equipment, designed and built by The American Laundry Machinery Company, is one of a group of machines that is set up on a looped assembly-line basis and makes it possible with but three girls to turn out more than 100 shirts an hour. And the garments are as beautifully pressed, we are told, as the most skilled housewife could do them with her hand iron.

The first step in the sequence from damp-work box to folder, involves the sleeves, which Operator No. 1 pulls down over a pair of forms to condition them so that the inside surfaces will not stick together during pressing and to set the folding lines. This is but one of a number of duties she must perform with dispatch but without physical effort within the radius of her station. From the forms she transfers the shirt successively to a sleeve press, a cuff and gusset press, and a collar press (the first two are of the twin type, finishing both sleeves or cuffs simultaneously).

Ironing in all cases is controlled by electropneumatic timers, and all machines are so coördinated that each is released after it has done its work and before the girl is ready to remove the shirt from it, thus permitting her to have as many as four shirts in process at a time once production is underway. Her allotted duties end when she takes the shirt from the collar press and hangs it on a rack within easy reach of Operator No. 2.


CAMS ON TIMER
PRESSURE CAM
TURRET CAM
INDICATOR LIGHT CAM
PETCOCK
TURRET TURNING CYL.
CAM ON END OF TURRET
FOOT CONTROL
BUCK WING RETRACTING CYL.
FRONT CHEST CYLINDER
AIR INLET
FILTER
OILER
TO COUNTER
REAR CHEST CYLINDER
BUCK WING EXPANDING CYL.
SNUBBER ARM
TURRET INDEXING MASTER VALVE
SAFETY CUT-OFF CONTROL
DIAPHRAGM
TURRET SNUBBER CYL.
SNUBBER
WING CIRCUIT
TURRET TURNING CIRCUIT
WING CIRCUIT
FROM SAFETY CONTROL

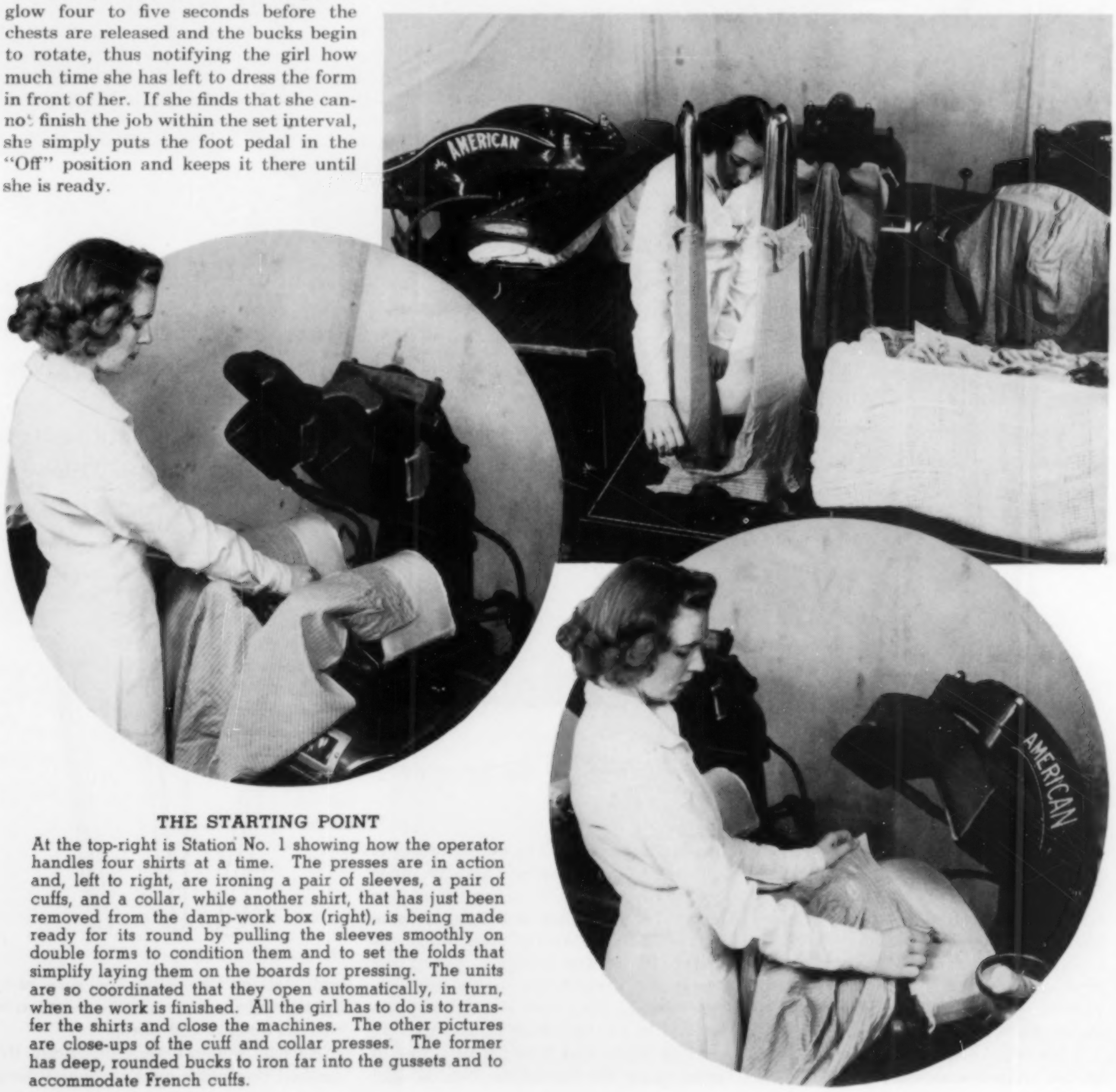
AIR FLOW CHART AND OPERATING FEATURES OF BODY PRESS

This brings us to the new air-powered Formatic Press that irons the body of one shirt while another is being made ready for pressing. This machine has two bucks or forms which automatically rotate, one into position between two highly polished steam chests and the other for dressing. The chests are shaped to fit tight against every part of the shirt, the one that irons the front moving forward and pushing the buck against the back chest, which exerts final pressure. Both bucks and chests are operated by pneumatic cylinders, as is the turret that turns the forms.

The working cycle is started by placing a foot pedal in the "On" position, turning on the main air-supply line, and pressing a button that actuates the electropneumatic timer which controls the movements of the press and determines the ironing period. The timer functions continually and causes a green light to glow four to five seconds before the chests are released and the bucks begin to rotate, thus notifying the girl how much time she has left to dress the form in front of her. If she finds that she cannot finish the job within the set interval, she simply puts the foot pedal in the "Off" position and keeps it there until she is ready.

As it takes only about 27 seconds to iron the body and bosom of a shirt, the operator's fingers move nimbly as she lowers a clamp that holds the collar and top smoothly in place and puts the tails under fixed straps—one in front and two in back. Then she expands padded wings at the sides of the buck with air under pressure. This draws the shirt taut and is done by pushing a lever. Just before the form is squeezed between the steam chests the wings are further expanded pneumatically, thus making it possible to iron shirts of different sizes with the same setup. Should the shirt front need dampening, there is a spray gun for that purpose within convenient reach. At the predetermined time, the bucks change places, the girl removes the completely ironed shirt from the form facing her, hangs it on a steam-heated collar form, and buttons the collar.

Operator No. 3 now takes over. She does the folding on a special table with a sloping top that can be adjusted to any comfortable working height. By aid of a spotlight in the center of the table she lines up the button strip of the shirt laid front down with the collar over a contracted form. The latter is electrically heated and neatly shapes the collar when expanded by releasing a treadle. A polished metal blade serves as a folding guide. With a piece of chipboard clipped to the underside, it is dropped onto the shirt and enables the girl to fold the sides and sleeves, to close a shoulder clamp, to turn up the tail, to apply the familiar paper band, and then to insert the collar protector. With both hands free, she can do the work with such facility that it is possible for her to get the shirts ready for delivery as fast as they come from the big new press.



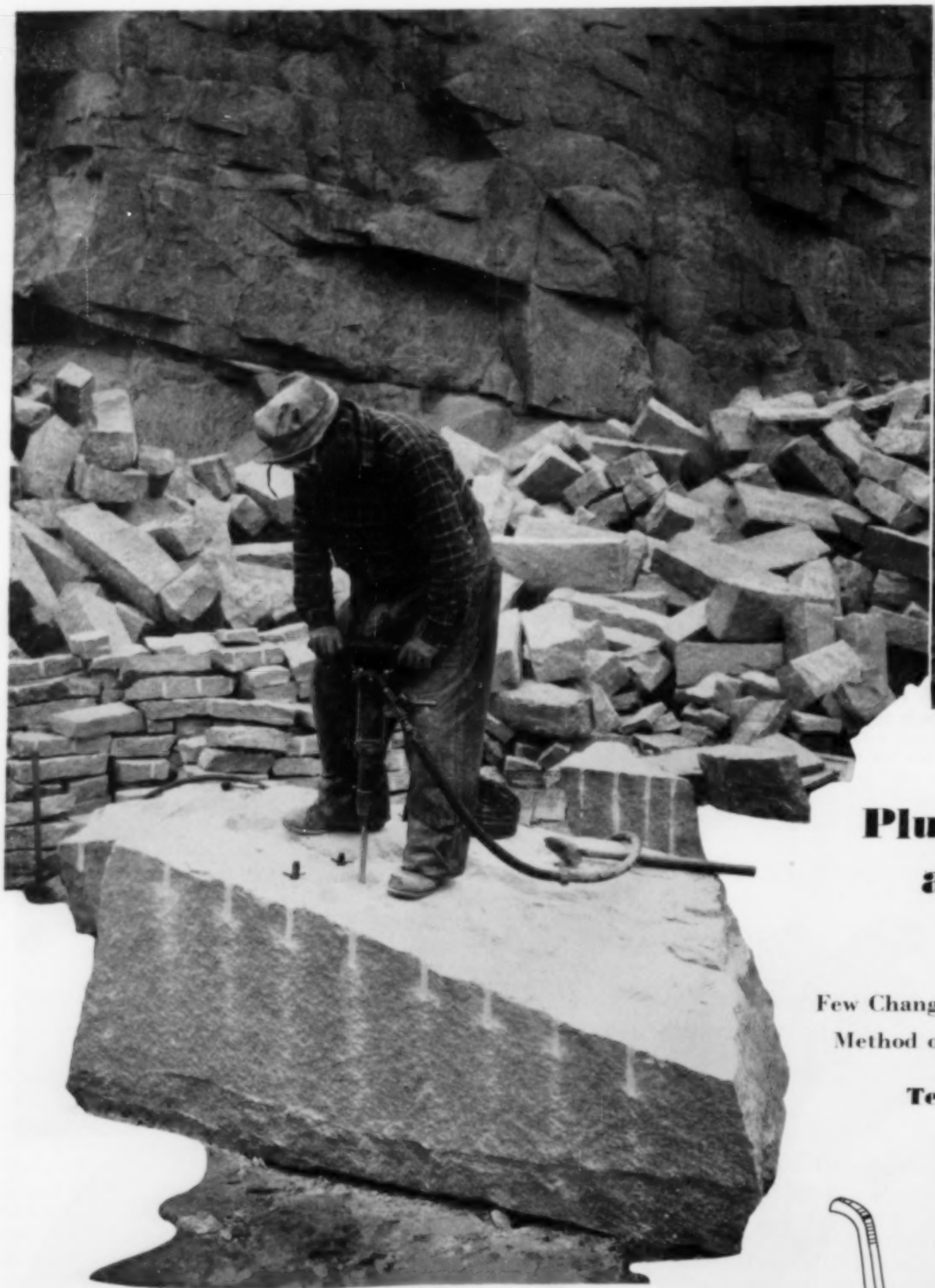
THE STARTING POINT

At the top-right is Station No. 1 showing how the operator handles four shirts at a time. The presses are in action and, left to right, are ironing a pair of sleeves, a pair of cuffs, and a collar, while another shirt, that has just been removed from the damp-work box (right), is being made ready for its round by pulling the sleeves smoothly on double forms to condition them and to set the folds that simplify laying them on the boards for pressing. The units are so coördinated that they open automatically, in turn, when the work is finished. All the girl has to do is to transfer the shirts and close the machines. The other pictures are close-ups of the cuff and collar presses. The former has deep, rounded bucks to iron far into the gussets and to accommodate French cuffs.

Plug and Feather

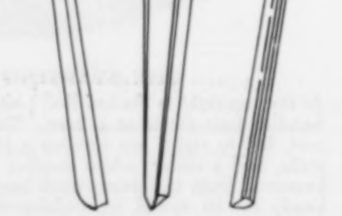
Few Changes Made in Ancient Method of Splitting Stone

Ted Slager



DRILLING HOLES

The J-10 Jackhamer being used here is a recently developed drill that weighs only 14 pounds. It is fitted with ⅞-inch hexagon steel.

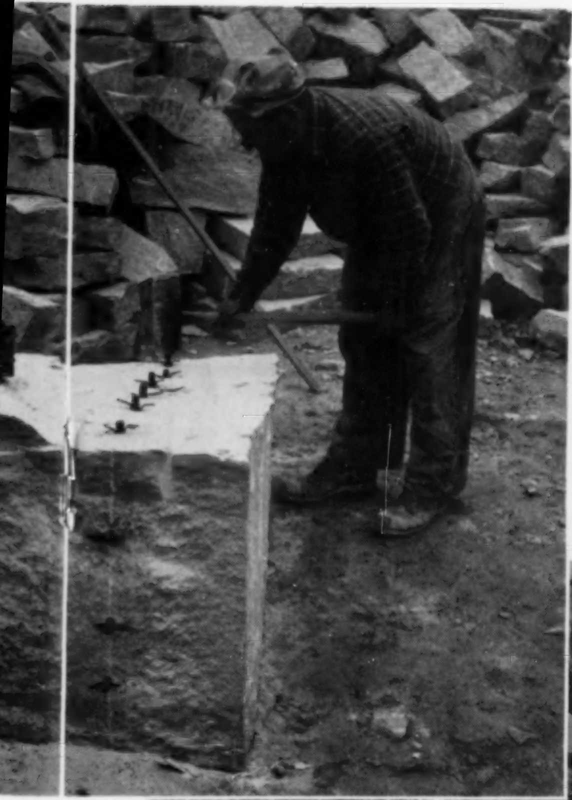


ONE of the oldest known methods of splitting rock, the plug-and-feather, is still used extensively by quarrymen and stone dressers to produce blocks of desired dimensions. With it, experienced craftsmen who know the structure and the rupture resistance of varying types of rock can fracture building stones with surprising accuracy.

A feather is a strip of iron with a cross section shaped somewhat like a first- or last-quarter moon. The outer surface is curved to fit a round hole and the inner one is rather flat. Two of these shims are inserted in a shallow drill hole, and the plug—a 4-faced tapered steel wedge—is driven in between them. When the wedge is hit repeatedly with a hammer, pressure on the stone is gradually increased in two opposing directions. By putting plugs and feathers in a row of holes along the line of the desired split and striking the plugs in turn, first lightly and then harder, the rock can be cleaved quickly and evenly.

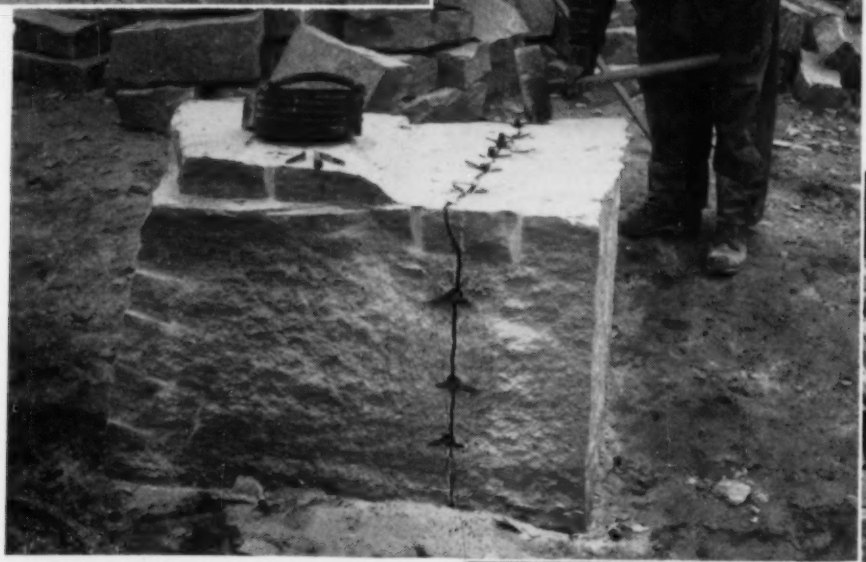
Ancient stoneworkers practiced this method or similar ones to quarry large blocks and then to reduce them to size. Their drills were tubes, probably of copper, which were rotated while some abrasive such as sand or emery was fed beneath the cutting edge. This laborious process eventually resulted in a hole with a central core that was broken out and removed. The first wedges, which were no doubt inserted without side pieces, were of absorbent wood. After being driven home, they were soaked with water to expand them and thus to build up pressure. In cold climates, freezing the water accomplished the same purpose. As ferrous metals became available, blacksmiths made plugs and feathers that differed little from those now used. Chisel-edged drill steels and hammers with which to pound them in were introduced at the same time as a substitute for the slower tubular drills.

Although it serves mostly for breaking crystalline igneous rocks such as granite, the plug-and-feather method is applied to marble and sandstone. Experience is the best guide in determining the number of holes and the depth to which they should be drilled in order to produce a clean, straight rupture without wasting stone, time, and effort. According to *Mining Engineer's Handbook* by Peele, a granite block 6 feet thick can be split by spacing 5-inch holes from 6 to 8 inches apart. For a 3-foot block, they need be but 2½ to 3 inches deep. Marbles and sandstones require deeper holes.

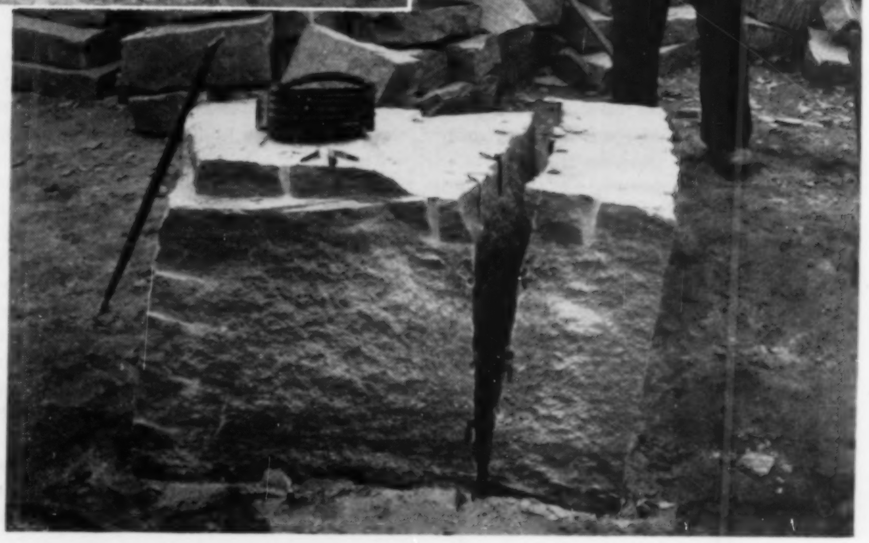


STARTING THE BREAK

Left—The plugs and feathers have been inserted and the workman is bringing his sledge down on one of them. Holes corresponding to those on the near side of the stone have been drilled on the opposite face. Drill marks visible along the left end and the top of the near face show how this block was separated from a larger one by the same procedure.

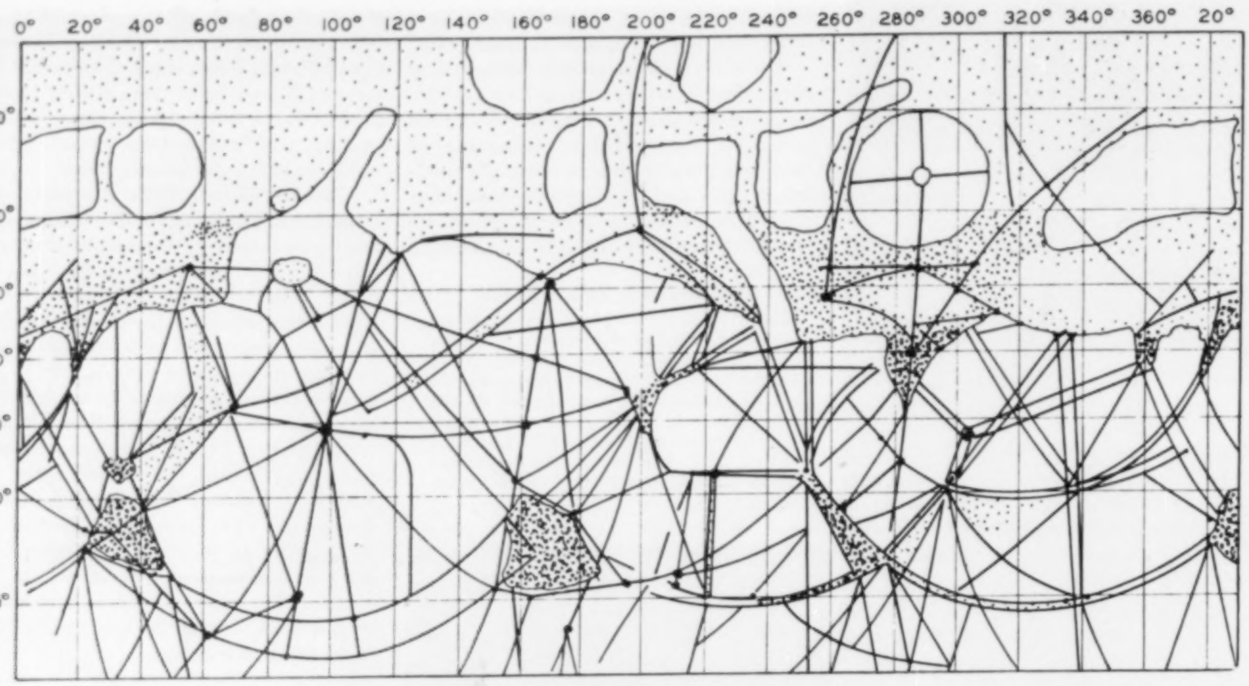


Mechanical rock drills are now used almost universally to do the drilling, and improvements in equipment of this type have served to speed up plug-and-feather work. With the light, easily handled machines now available, and the fast-cutting detachable bits with tungsten-carbide inserts, a hole of the required depth can be drilled in granite in a matter of seconds. The accompanying pictures were taken in the Mile Square Granite Quarry, Yonkers, N. Y., and show the sequence followed in plug-and-feather operations. The stone, which occurs in such colors as brown, light-brown, and gray has been used extensively in the building of churches, schools, and homes in the East as well as bridges on New York State parkways.



THE FRACTURE

Each wedge is struck in turn, first lightly and then with greater force. After this sequence has been repeated a few times, pressure builds up to the breaking point, splitting the block along the desired line and with an evenness that reduces wastage and calls for little additional work in dressing the piece to final dimensions.



A MERCATOR PROJECTION CHART OF MARS

This simplified drawing, made from one that appears in one of Percival Lowell's books on Mars, shows the criss-crossing lines that have been assumed to be canals. The author believes, however, that the known facts and observations of the planet indicate that they are more likely railroads or some other sort of travelways bordered by planted areas. This would explain why they are visible from the earth at certain times of the year and fade in others and why they apparently change color between growing seasons. The dots represent cities.

The Canals of Mars

So-called Waterways Considered More Likely to be Planted Strips Along Travel Arteries

James R. Randolph

SEEN through a telescope the planet Mars exhibits two white caps at the poles, advancing and receding with the seasons like the polar caps of the earth, while the space between is composed of irregular patches of orange-red and bluish green. The red ones are known to be deserts. The blue-green ones were at first thought to be seas and are still called *maria*, which is Latin for seas. But they are now known to be areas in which, for some reason, more vegetation grows than on the deserts.

Crossing both deserts and *maria* are many fine dark lines which, when first discovered, were called *cannalli* and are still termed "canals." They are not easy to see. Under ordinary conditions the constant wriggling of our own atmosphere blurs the image so as to make such fine details invisible. But even under poor conditions the wriggling may stop for a moment and permit the lines to be glimpsed briefly. Under very good conditions such as those often prevailing at the Lowell Observatory at Flagstaff, Ariz., they can be seen rather easily.

The late Percival Lowell, founder of the observatory, devoted his life to the investigation and mapping of these canals and has left the world not only a fairly complete and accurate map of them but also an extensive account of their behavior. His studies are described in his books, *Mars and Its Canals* and *Mars as the Abode of Life*. Subsequent observers have in the main confirmed his findings, or at least have not united for the purpose of disagreeing with him.

Lowell discovered that the canals, in order to be visible from the earth, would have to be dark strips from 10 to 20 miles wide. That made it seem unlikely that the things we see are actual waterways. He considered it more likely that their presence is made visible by broad strips of irrigated land flanking them rather than by water itself. He also observed that they are not noticeable throughout the year.

Mars has seasons very similar to those of the earth but nearly twice as long, and after each solstice the canals all over the planet are well-nigh invisible. As spring comes to each hemisphere in turn, however, the polar snows start to melt. A dark-blue band that reflects light as if it were water forms around the edge of the melting cap. The canals begin to show near this band, and as spring advances they advance from the pole to the equator and beyond. They fade with the approach of autumn, and appear again at the other pole.

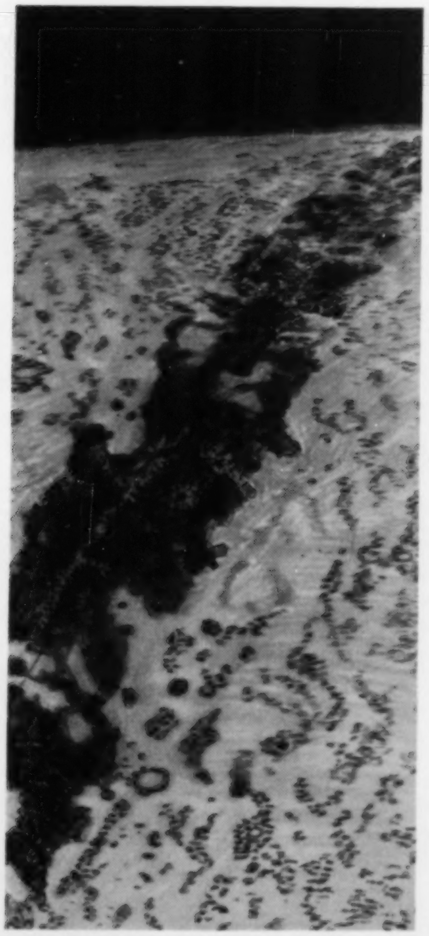
The rate at which the visibility of the canals creeps southward or northward over the planet is about the same as that at which water, released by melting snows, would crawl through a long network of irrigating channels. So Lowell believed that the fine dark lines really represented water channels, and made some calculations as to the power that would be required to pump the water.

As the canals become visible, the desert flanking them changes from red towards yellow. The transformation can be demonstrated in the laboratory by scattering green confetti over a red surface and viewing the result from a distance at which the details disappear and only the mass effect is seen. The *maria* also change to a deeper, richer green.

Lowell's map of the canals does not conform to the theory that they are irrigation or water channels. They are too straight; too much at variance with those slight changes in elevation that isostasy would produce even on a planet where there are no mountains. His chart looks more like a railroad map of a flat country, or like a college campus where students have worn paths across the grass from one much-used door to another.

Our modern knowledge of the climate of Mars increases our tendency to think of the canals as a transportation rather than an irrigation network. For we now know that there are no parts of Mars where the mean daily temperature is above freezing for very long at a stretch. Daytime temperatures as high as 80°F. have been recorded in the *maria;* on the desert they are rarely more than 50°. Temperatures generally drop to freezing after sunset and are close to zero at sunrise. Mean annual temperatures are below freezing.

These facts about the climate clear up the mystery of what became of the planet's water. Its oceans are still there in what we call seas, but they are solidly frozen all the way to the bottom and drifted over with wind-blown soil. Plant life can grow in this soil more abundantly than on the deserts because it can get water through the seasonal melting of the ice beneath.



AERIAL VIEW OF "CANAL"
This drawing is the author's conception of how one of the populated strips would appear from 100 miles aloft.

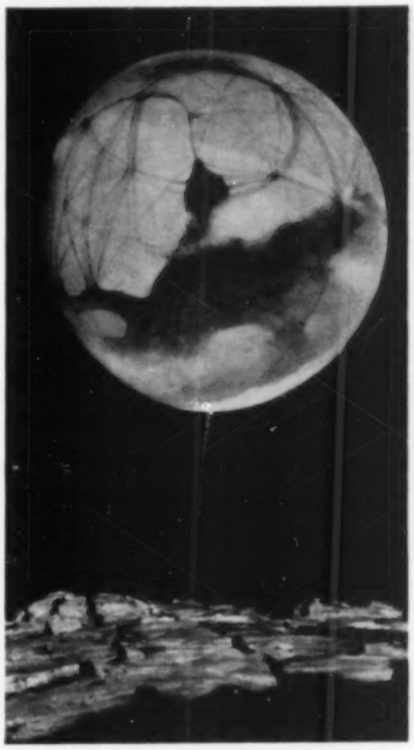
Other things we have learned about the climate give a simpler explanation for the seasonal behavior of the canals. The theoretical temperature of a planet's surface is computed by balancing the heat received from the sun against the heat radiated off into space. But the theoretical temperature is always below the actual temperature if radiation at night is checked by the formation of clouds. Clouds form when the air is cooled to its dew point, which depends upon the amount of moisture in the air. When the moisture content rises, the temperature at which clouds form also rises and their heat-trapping effect begins sooner after sunset, raising the average temperature of the day.

There is a pronounced tendency for the humidity of desert air to stabilize at the degree that will give a dew point of 32°F., for moisture which condenses at higher temperatures will run off as water, while that condensing at lower temperatures will turn into snow and stay in place and reëvaporate next day. So what happens in the Martian spring is that the water vapor from the melting snows keeps the heat from escaping at night, increases the temperature, and permits vegetation to become active. As the moisture spreads through the air from one polar cap to the other this heat-trapping effect extends toward and across the equator until it reaches latitudes where the sun is still too low to make the average daily temperature rise above freezing.

Spread of this moisture, together with its heat-trapping effect, progresses at the same rate as would water flowing in canals. It explains the observed seasonal behavior just as well, but requires only vegetation naturally adapted to the climate and not plant life that has to be irrigated.

Desert areas on earth are small and have been left to backward peoples. The development of plants fit for human needs has been for the most part confined to species that grow in well-watered regions. However, recent experiments have shown that cactus, gourds, and other kinds of desert vegetation also could be transformed into useful food plants if there were sufficient incentive to do so.

If Mars is inhabited it would be only natural to suppose that the people had made useful crop plants out of desert vegetation and therefore would not require extensive irrigation systems. It would also be reasonable to assume that, since the basic industry of a desert is apt to be livestock rather than agriculture, the farming area would be small and would be within the immediate neighborhood of homes.



AMERICAN MUSEUM OF NATURAL HISTORY

VIEW FROM SATELLITE
Here artist H. R. Butler shows Mars as astronomers believe it would appear to an observer on its outer satellite, Deimos.

If, then, we suppose that the Martians prefer to live within shopping distance of a main line of transportation, we have all the ingredients for a theory that completely explains the canals. This theory assumes that each canal is a railroad or a main highway following the shortest possible route between cities and that that artery is flanked by strips of land where conditions are favorable to homesteaders. There the people have built their houses and cultivate their crops and orchards. Beyond the strips are open ranges where their stock is turned out to graze until it is driven in to be fattened and slaughtered for the winter's food supply.

So much for the deserts. In the *maria* the widely distributed blue-green color suggests either better pasture or, more likely, vast arable reaches like American wheatlands. Certain of these areas have been seen to turn the color of plowed acres at a time of year when that work would be done. But there, too, the people seem to live near the railroads and to cultivate the stretches alongside more intensively than they do the backlands

In both desert and *maria* the theory expounded completely explains the appearances and behavior patterns of the canals. There are no details which it fails to fit.

Compressed Air at Work

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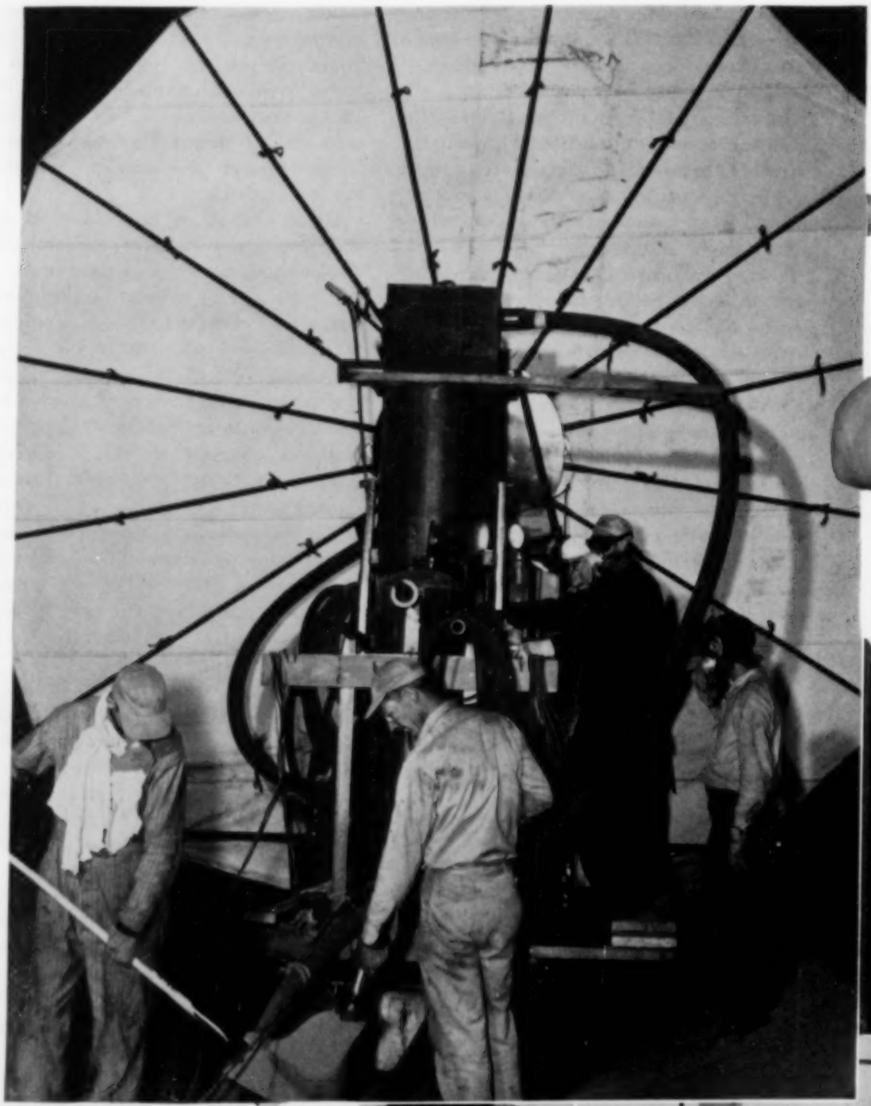
The rig shown at the right was developed for cleaning prior to painting the inner surfaces of steel-lined concrete pipe on the U. S. Bureau of Reclamation's Columbia Basin Project. The machine is being fed with sand, which is blown by compressed air against the pipe through four revolving arms located on the other side of the protective shield that is supported by radial steelwork. The arching hose is the air line. The rig is mounted on a pneumatic-wheeled carriage and, when operating, moves along the pipe invert at a speed of 5 inches per minute.



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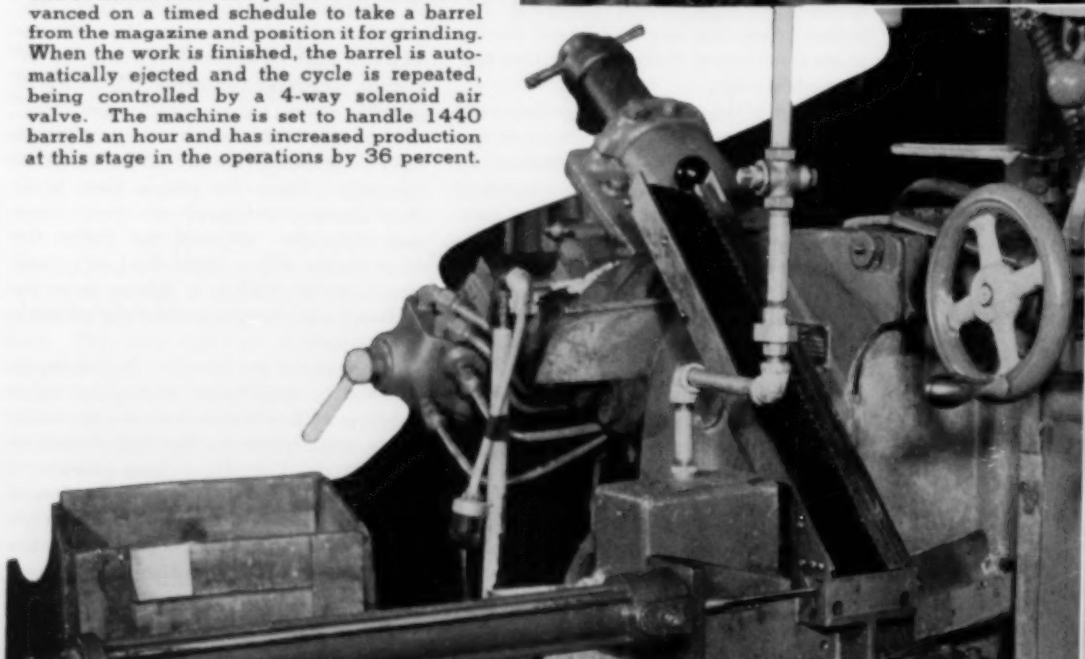
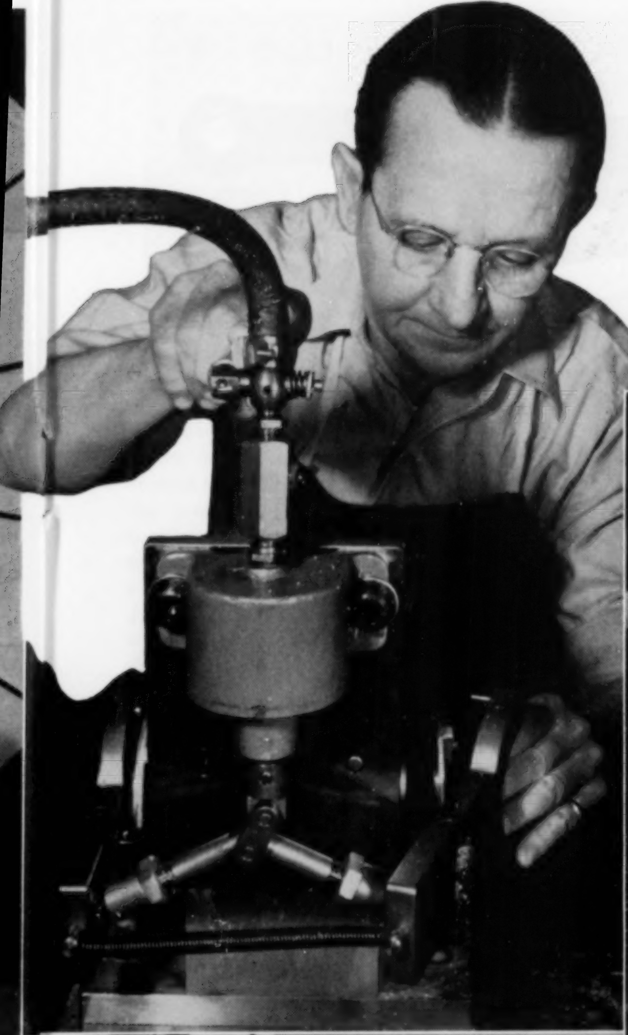
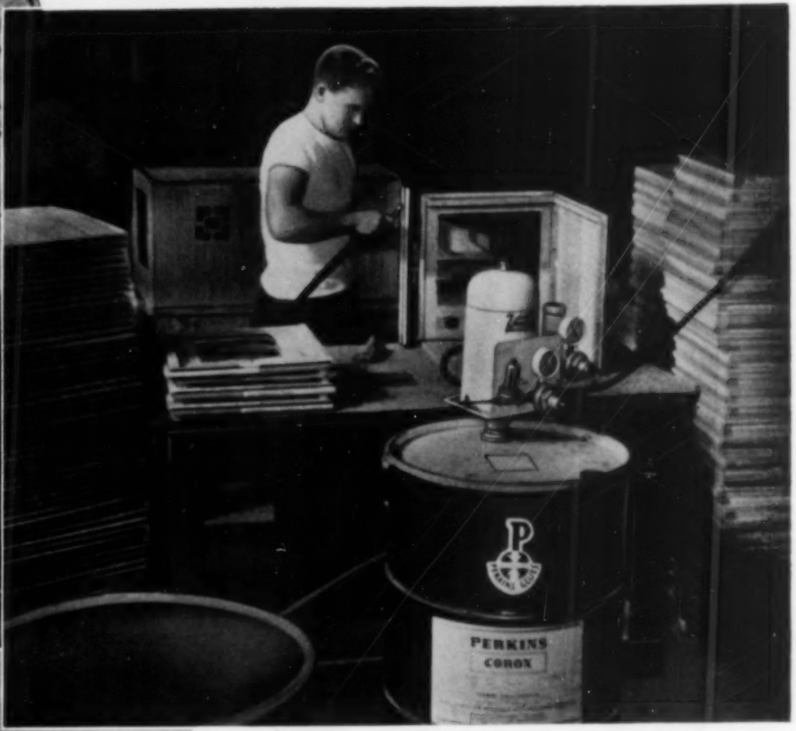
The picture below shows a setup at Parker Pen Company, Janesville, Wis., for automatically finish-grinding plastic barrels of fountain pens. The barrels are fed by gravity from the inclined magazine at the right. Projecting at the lower left is an air cylinder from the right end of which extends a pin or arbor that is advanced on a timed schedule to take a barrel from the magazine and position it for grinding. When the work is finished, the barrel is automatically ejected and the cycle is repeated, being controlled by a 4-way solenoid air valve. The machine is set to handle 1440 barrels an hour and has increased production at this stage in the operations by 36 percent.





By means of the fixture shown at the left two aluminum castings are clamped in position for precision boring in the plant of Skilsaw Inc., Chicago manufacturer of electric and pneumatic tools. The piston of a vertical 2-inch air cylinder actuates linkage to move side arms that hold the pieces securely while they are being bored consecutively by opposed heads. The parts can be mounted separately. A spring between the arms retracts them when the air is released.



When an air-operated pump made by Perkins Glue Company, of Lansdale, Pa., is mounted on a standard 55-gallon drum, it will move liquid glue through hoses to points of use several hundred feet away or on another floor. The picture above shows an operator applying adhesive in the Louisville, Ky., plant of the Castlewood Manufacturing Company, a leading maker of wood products. The glue flows from a flexible nozzlelike applicator when the latter is bent slightly and stops flowing when the pressure of the hand is released. The pump operates with air at 20 psi. pressure, and one unit will supply several applicators.

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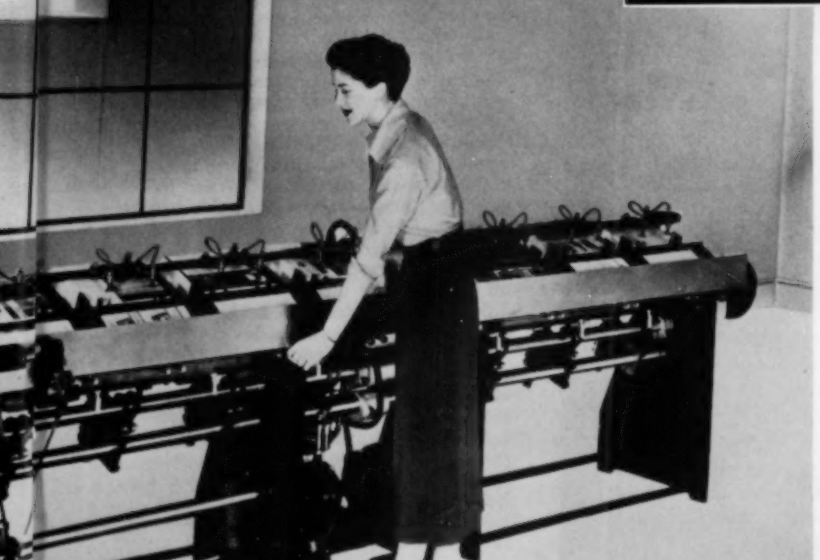
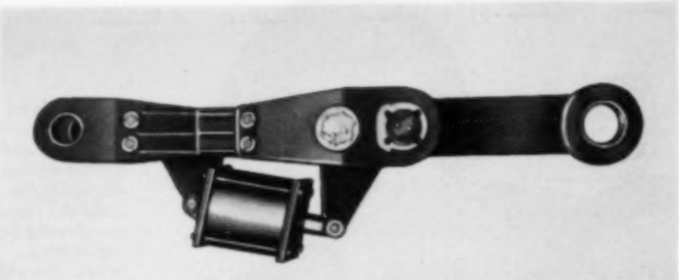
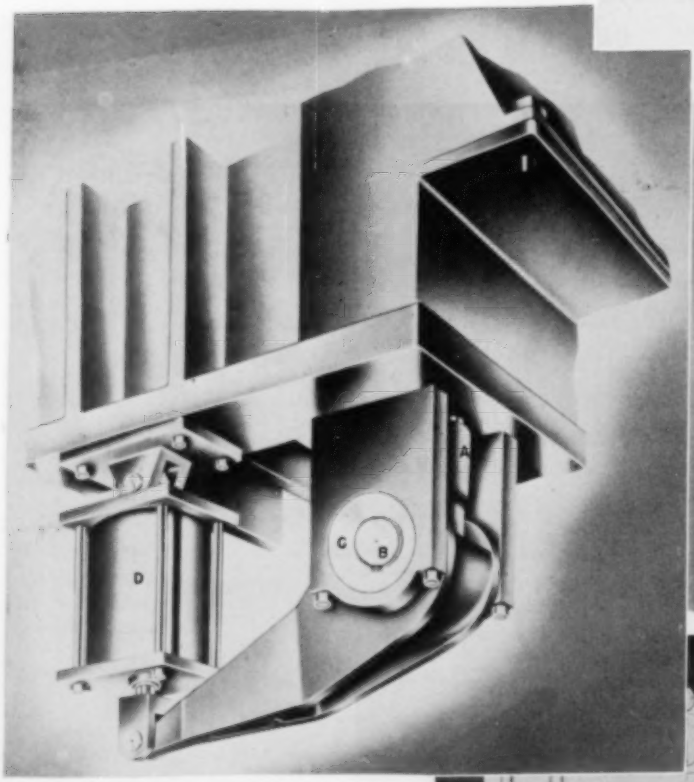
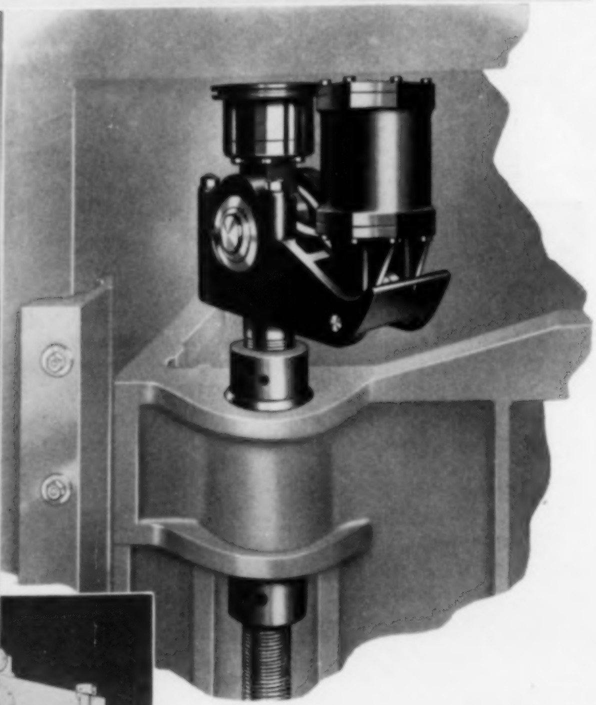


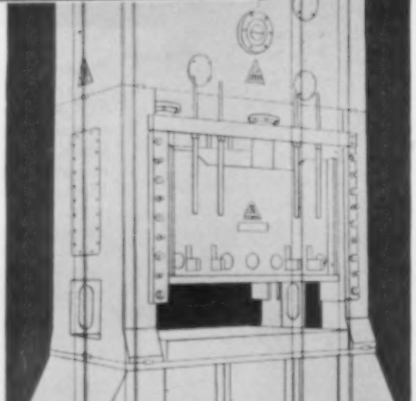
The machine shown at the left will gather 25,000 sheets of paper of 9½x12-inch size into sets of eight in an hour. Built on the conveyor principle, it has eight compartments for the stock. Each sheet is picked up in turn by suction and placed on the belt so that each set is assembled in the desired order. To prevent picking up two sheets at a time, a blast of compressed air directed from one side separates the top sheet from the pile. Known as the Macey Collator and sold by the Harris-Seybold Company, of Cleveland, Ohio, the machine will handle any weight of paper from 9-pound basis to ⅛-inch cardboard and will gather the stock into sets of from two to eight pages each. It works from five to eight times faster than trained girls who ordinarily do the collating in printing plants and offices.

Overload Safety Device for Presses









INSTALLATION VIEWS

Pictured at the bottom is a single-action press with a Loadtrol connected to the lower end of each of its four tie rods. By yielding with the latter, the units protect dies and presses from damage through overload. At the top-left is a close-up of the safety device. Coupling *A* links the tie rod and shaft *B* mounted in the lever-arm trunnions *C*. When air at 80 psi. line pressure is admitted to cylinder *D*, the piston and attached lever arm exert a constant preloading pull on the tie rod. In the top view, the unit is mounted directly on a special link for an underdrive press. If the link is under compression, the device, in effect, permits it to elongate slightly—to complete the stroke without damage—or, if under tension, to contract when the preset pressure is reached. Directly above, it is shown connected to one of the outer slide plungers of a double-action press. Each corner of the blank holder can thus be put under different pressure by regulating the air pressure.

FOR use with its single- and double-action mechanical presses, Clearing Machine Corporation has developed a safety device called Loadtrol which protects dies and press parts against damaging overload caused by double headers, stock variations, etc. The unit consists of an air cylinder and of a lever arm to which the piston is connected. Mounted eccentrically in the lever-arm trunnions is an independent shaft that is attached through a coupling to the press tie rod, plunger, or drive link which is under stress during the load period. When the force exerted on the member is greater than the preset maximum, the Loadtrol yields with the part, thus neutralizing the excess pressure. To avoid continued overload, the attachment is provided with an electric device that automatically disengages the clutch when the prescribed pressure is reached. The Loadtrol is also suitable for service where a substantial load is intermittently applied in tension or compression because it allows the member involved either to contract or expand.

In addition to standing constant guard over dies and presses, the safety device offers other advantages. Because maximum operating pressures can be predetermined and regulated at will without any slide adjustment or change in position, tryouts and die setting are said to present no difficulties. Further, the unit makes it possible in a matter of minutes to preload or release tie rods while cold; and when the use of small dies calls for less than full press capacity, the Loadtrol is set accordingly and safeguards the dies. Accompanying illustrations show the unit and different applications.

EDITORIALS

THE TOLL ROAD RETURNS

THE first white settlers in America traveled largely by water, and most of the early roads were short stretches around towns and villages. As the growing population fanned out from the eastern coast, need arose for intercommunity roadways. There being little public money with which to build them, private citizens began to finance construction under charters that permitted them to collect tolls from users. This practice was initiated about 1795.

The thoroughfares were called turnpikes and were unsurfaced dirt roads that followed the relief of the land irrespective of gradient or curvature. Later ones were covered with broken stone, which was worked into the ground by vehicles drawn by horses. Railways sounded the death knell of toll roads. By 1850, many of them were freeways, although a few such as the Old York Road, extending from Philadelphia towards New York, and the Baltimore and Lancaster Pike, which also ran through Philadelphia, continued to collect fares until much later.

Concurrently came gradual acceptance of the idea that it was incumbent upon governments to build and maintain public highways. At first that was largely left up to the individual counties, and it was not until 1891 that New Jersey set a precedent by passing a law providing for state aid. By 1913, similar help was being given by 42 states. Then came state highways and federal aid.

An era of feverish construction to keep abreast of mounting automobile traffic was ushered in. In the main, established roadbuilding agencies were able to cope with the demand, but in thickly populated sections even their best efforts did not suffice. In certain localities the need for high-speed superhighways, designed to move traffic with a minimum of interruption, brought back the toll road. This time, however, public agencies rather than private companies are putting up the funds and amortizing the investments with the proceeds.

Although the trunklines are creations of the states concerned, the fact that they are not constructed with taxpayers' money gives their designers a freer hand in laying them out than would otherwise be possible. They can specify the shortest or most favorable routes, and can by-pass cities and towns without fear of becoming embroiled in political complications fomented by local interests. They can largely eliminate cross roads, traffic lights, and other deterrents to fast and safe driving. Permissible speeds can be set according to prevailing conditions affecting safety and without regard to laws applying to conventional highways.

There is an essential difference between the present toll road and its earlier counterpart. The first payways usually were the only routes available for making the trips concerned. Travelers either paid or they didn't go. The modern thoroughfares, on the other hand, are optional routes. Those who prefer to use the free highways may do so. The public, however, has shown willingness to patronize the new facilities, having quickly recognized their time-saving and safety potentialities. Both individuals, whether bent on pleasure or business, and public carriers have found them much to their liking.

The first of the new toll roads, leading northward from New York City, was so successful from the outset that it was extended. As its advantages were demonstrated, the New England States were prompted to plan connecting links, some of which are already in service. To carry the system southward, New Jersey is now constructing a throughway that will run the length of the state.

The first East-West toll highway was the Pennsylvania Turnpike, extending for a distance of 160 miles from Carlisle, near Harrisburg, to Irwin, near Pittsburgh. It was received so well that a connecting link of 100 miles from Carlisle to Valley Forge, near Philadelphia, was opened last fall. The latter section more or less parallels the Old York Road, and it is significant to note that Pennsylvania has stuck to the nomenclature of the forefathers in retaining the designation of turnpike.

The 1950 report of the commission that operates the route across the Alleghenies furnishes ample proof that it provides a much-needed service for which the public is glad to pay. Including 42 days of operation of the eastern extension, the year's traffic totaled 4,488,538 vehicles and receipts amounted to $9,022,398. That is an increase of 16.6 percent in vehicles and 28 percent in revenue over the 1949 figures. The fare-paying cars traveled 450 million miles, while nonpaying ones—police, maintenance, and service vehicles—accounted for 23 million more miles.

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STONE FOR BEAUTY

UNTIL concrete and steel appeared, stone was the only acceptable material for constructing buildings and other works designed to last a long time. Through the ages, it has demonstrated that it looks well and wears well. It is significant that most of the world's famous architectural structures are built of stone, regardless of the country of their origin. No other material is so completely pleasing to the eye and none, no matter how strong, gives the same comforting feeling of stability. Unfortunately, the quarrying and cutting of dimensional stone still call for great expenditures of labor, whereas competing materials can be turned out by mass-production methods. Thus stone finds itself at a growing disadvantage as regards cost.

Producers of stone, especially of granite, have been perturbed in recent months because they have been losing business that traditionally has been theirs. They have been particularly concerned over an apparent movement to substitute other materials for stone in building bridges on the highways and parkways of New York State. In protesting this course of action, they are seeking first of all to protect their own means of livelihood, but there is also something at stake that affects the public interest.

Anyone who has driven over some of the magnificent parkways in the environs of New York City has unquestionably been impressed by the beauty of the stone bridges with which they abound. Although the visitors who admire these structures do not pay the taxes that make them possible, they cannot help but feel that they are well worth their cost. The stone producers feel the same way, aside from their interest in wanting to keep the business.

It is claimed that there has been no maintenance expense in connection with those bridges since they were constructed. That fact, the suppliers of stone believe, should be given consideration when comparing the first cost of stone and that of competitive materials. As for appearance, it is acknowledged that time and weathering steadily enhance the beauty of the structures. It could be that those who control the expenditures for these purposes would be penny-wise and pound-foolish if they were to veer from the established practice of choosing stone.

This and That

Exit Peat Bogs

For centuries the peat bogs near Emmen, Holland, have been the main means of support of the town's populace, with employment ranging around 2000 persons. Now the bogs are giving out, and it is estimated that there will be no more peat to dig in ten or fifteen years. To take up the slack in employment, an industrialization program has been launched, financed largely with Marshall Plan funds from America. A nylon spinning plant is now under construction.

* * *

Better Cold Trap

The efficiency of a household refrigerator is obviously reduced if warm air seeps into the cabinet. The gasket that forms the door seal is, consequently, of prime importance. That on the old-fashioned icebox door was made of cord and oilcloth. It was considered to be doing a good job if it kept the temperature as low as 50°F. "Wirf" strips similar to present-day weather stripping were tacked on the wooden doors of the first mechanical refrigerators. Natural-rubber gaskets were introduced in 1931. Combined with improved insulation and refrigerator design, they make it possible to maintain temperatures that range from zero and below in the freeze chest to around 40°F. in the main food compartment. Now B. F. Goodrich Chemical Company has come along with Geon plastic gaskets that are reported to be far superior to rubber. They are more resistant to cracking and brittleness, and are less affected by solvents, greases, and the perspiration from human hands. In laboratory tests, doors provided with the new seal were opened and closed more than a million times, equivalent to 27 years of service with 100 openings a day. Recent advances in the price of natural rubber have made Geon a cheaper material and spurred its introduction. So far one major refrigerator maker, Westinghouse, has specified it for its 1951 models.

* * *

King Solomon's Mines

A quest for water in the Saudi Arabian desert ended in the discovery of ancient gold mines that may have enriched King Solomon, and one of the deposits is now being worked. The story is told by K. S. Twitchell, general manager of the operations, in the December, 1950, issue of *Asarco News Letter* published by American Smelting & Refining Company.

In the 1920's, Mr. Twitchell traveled 1500 miles of the desert at the behest of King Ibn Saud looking for sweet-water reserves. He found no water but did locate evidences of ancient mine workings and traces of oil. Impressed, the king authorized further exploration, which revealed a total of 55 mining sites. Only one of them, at Mahad Dahab, 250 miles northeast of the port of Jidda, was found upon investigation to justify the expenditures necessary to resume production.

At the site in question, approximately 480,000 tons of residue from former milling operations was divided into two layers, indicating two distinct periods of activity dating back perhaps 3000 and 1200 years, respectively. Particles in the bottom zone ranged up to 1 inch in size, while those in the top layer averaged 10 mesh. Hundreds of lava grinding wheels, around 20 inches in diameter and 5 inches in thickness, were uncovered, some of them unused. They had been utilized to reduce the ore after it had been broken down with stone hammers to sizes that could be ground. After grinding, the ore was concentrated by washing it over inclined tables, parts of which were still projecting from the walls of the ruins. The concentrates were further reduced before their gold content was fused in furnaces. Remains of the latter, with associate slag heaps, established that fact. As no broken pottery was in evidence, it is assumed that water for the operations was carried into this arid region in skin bags.

JERUSALEM
SAUDI
MAHAD DAHAB
MECCA
JIDDA
RED SEA
ARABIA
AFRICA

The Saudi Arabian Mining Syndicate, Ltd., was formed to reopen the property and was taken over in 1935 by the American Smelting & Refining Company. The Saudi Arabian Government and about 75 citizens of the country own some of the stock. Initial activities consisted of reworking 380,000 tons of the old tailings, which averaged 0.4 ounce of gold ($14) per ton, in a combination cyanide and flotation mill. Appreciable quantities of charcoal, the residue of centuries of campfires, were mingled with the tailings and removed by floating them off.

Mining the old deposit in an open pit was then started, followed by underground development, which is now yielding all the ore treated. The known payable reserves extend to a depth of 500 feet, but diamond drilling has shown that the vein systems go deeper. The mill is now handling an average of 1500 tons monthly. Concentrates are flown to Belgium for upgrading, and the refined product is shipped to El Paso, Tex., for smelting. The Saudi Arabian operations provide employment for around 1000 natives and have brought about a town of 2500 population. Being devout Moslems, the workers pause for 25 minutes five times a day for prayer.

* * *

Smog Under Study

Observations made on a 410-foot tower by Dr. M. L. Barad, meteorologist of General Electric Company, may point the way to the alleviation of the smog nuisance and hazard that affect numerous industrial areas. At the Hanford (Washington) Works of the Atomic Energy Commission, Doctor Barad uses the tower to measure the temperature, and the speed and direction of the wind at various levels. Data gathered during three different fog periods indicate that there is a definite temperature pattern that may hold the answer to the smog problem. In each case, just before fog formed, there was a steady rise in temperature from ground level to an elevation of 100 feet. A few hours later, with the fog enveloping the area, the reverse was true. For 200 feet above the 100-foot level temperatures remained fairly constant, but in the uppermost 100-foot zone penetrated by the tower they increased. This would indicate, Doctor Barad points out, that if stack smoke and gases are exhausted at heights of less than 100 feet they will tend to settle. On the other hand, if they are discharged in the upper zone of rising temperatures they will be carried upward and dissipated.

* * *

Roving Swine Thwarted

Highway departments in states where livestock does not have to be fenced in are having trouble with hogs. The reflector beads on black-banded white posts that warn motorists of curves and soft shoulders attract the wandering porkers at night and they scratch and rub themselves on the posts. As a result, the reflectors become obscured with dirt and the entire post changes in color to a neutral gray that blends with the surroundings and is no longer readily visible. One state in the Southwest has outsmarted the hogs, however, according to the magazine *Better Roads*. There maintenance men drive a ring of 30-penny spikes an inch or so into the wood and at a height where the average-size animal makes contact. The heads of the spikes are then cut off and the projecting ends sharpened. Posts thus encircled stay clean and are easily seen after dark, while those without spines are defaced.

New Instrument Broadens Scope of Electron Microscopy

WITH the introduction of a table model electron microscope, the Radio Corporation of America has placed within reach of many laboratories, industrial plants, educational and medical institutions an instrument that, in the past, was available only in a much larger, costlier size and in a more complex form. The outstanding feature of the new microscope—the Type EMT—is its permanent-magnet lens system in which 4 pounds of magnet iron have been substituted for thousands of turns of coil wire, cables, connectors, and a 3-tube electronic circuit calling for heavy transformers—in short, have eliminated many of the controls of the earlier model.

The stream of electrons used instead of the familiar beam of light is generated by a heated wire filament, and its speed down the column is accelerated by a 50-kv. power unit. This gives the instrument its high resolving and magnifying power, which is said to be twenty times that of the best optical instrument. Another advantage is that it has a field depth 150 times greater, making it easier to bring all the planes of a specimen into focus. By photographic enlargement, according to the company, it will provide useful magnifications up to 50,000 diameters, with up to 6000 diameters direct magnification in the microscope.

The instrument is essentially a vacuum tube into which only a small amount of air is admitted when specimens or photographic plates are inserted or removed. Two pumps, in series, serve to maintain the vacuum: a small air-cooled oil-diffusion pump mounted behind the microscope column and connected by a suction line to a mechanical pump on the floor. Operating vacuum is restored within six seconds after introducing a specimen and within 1½ minutes after sliding in a plate. The camera is an integral part of the instrument, and the picture is taken by pulling out a knob and pushing it in again after a lapse of from one to three seconds. The specimens are easily withdrawn and inserted by means of a sliding rod and may be run in one after another by arranging them in a new type of holder before examination.

TABLE MODEL

Only 30 inches high, the new electron microscope, with its 50,000-volt accelerating potential, has high powers of penetration and produces well-defined images. This permits the study of comparatively thick specimens, which is of great advantage in the field of metallography, bacteriology, and medicine.

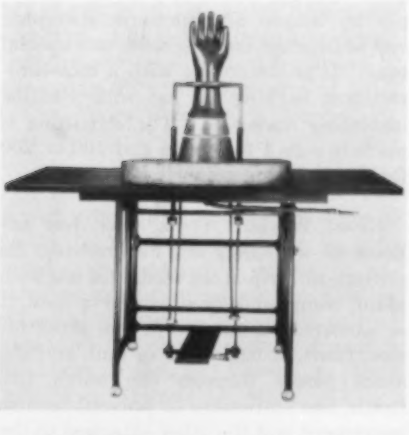
Rubber-Glove Inflator Expedites Inspection

A SIMPLE device for inflating rubber gloves so that they may be visually inspected quickly has been developed by the operating staff of The Ohio Power Company. Gloves worn by the latter's employees are examined periodically for cuts, cracks, scratches, and other physical flaws. In the past, the inspector pulled and stretched all parts of each glove to expose small imperfections and then twisted the cuff to compress air within the fingers and palm to detect leaks. This procedure did not permit testing the entire glove and imposed strains that sometimes led to failure.

The apparatus, which is illustrated, consists of a stand on which is mounted a conical wooden form that has a hole through the center for the admission of compressed air. After the cuff of the glove has been drawn on this form, a smooth circular retaining ring is brought down by the action of a foot treadle to hold it firmly and to prevent leakage of air. A valve is then opened by a push button to introduce air from the plant line.

Experimentation has shown that no more than 2 psi. pressure is needed to distend gloves sufficiently for visual inspection, and this is still well below the rupturing point. Instead of reducing the pressure to that point, however, the air is admitted at the line pressure of 25 psi. to expedite inflation and shut off when the size of the glove indicates that it is properly distended. With a little practice the operator can thumb the inlet-valve control so as to obtain the desired inflation each time. During examination he flexes and distorts the glove with his hands to expose even minute abrasions.

Jointly responsible for developing the machine are C. A. Bivenour, meter superintendent, central division; E. A. Grove, meter foreman, Coshocton, Ohio; and J. R. Padden, safety supervisor, Canton, Ohio. Both new and worn rubber gloves are inspected with the aid of the apparatus and are then subjected to the customary electrical tests.



INFLATED GLOVE ON STAND

The retaining ring, shown in raised position, is brought down by depressing the foot pedal and holds the glove securely while it is being flexed and distorted to detect flaws or leaks.

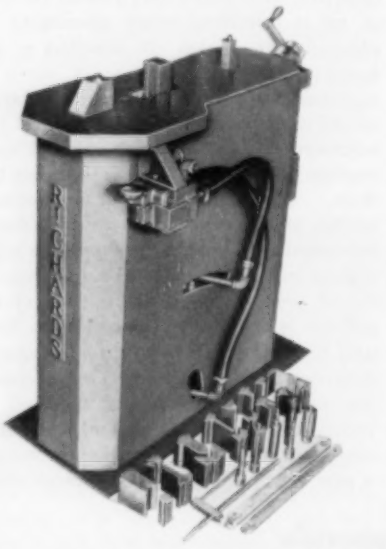
Foundations and Vibrations

ALL machines having high-speed rotating or reciprocating parts vibrate. Perfect balancing is impossible, and a foundation is usually required to counterbalance or absorb the vibrations. But a foundation, too, has what is known as a "natural period of vibration." Of course, it is lower in the case of a large massive base than in a small one. It follows, then, that if a foundation and the machine it supports have the same period of vibration, conditions are worse rather than better, for the machine's vibrations are transmitted to the base and the two together may become extremely violent. When the period is identical, the machine is sometimes wrongly blamed for the resultant annoying noises and vibration.

One of the most effective methods of eliminating troubles of this kind is to isolate the machine from the building or from the ground by means of a strong resilient material. Cork is usually specified. Cork has a natural period of vibration that is invariably different from that of any machine. It remains wellnigh perfectly elastic over a long period of years; that is, it does not gradually yield under pressure like most other materials, nor does it rot, warp, swell, or shrink. From almost every viewpoint natural cork is ideal for the purpose. Sometimes it is placed directly under the machine and on top of the foundation, and at other times the latter itself rests on the cork, depending upon conditions. Usually the job of isolation is one for an engineer who has had broad experience with all types of vibrating and noisy machinery.

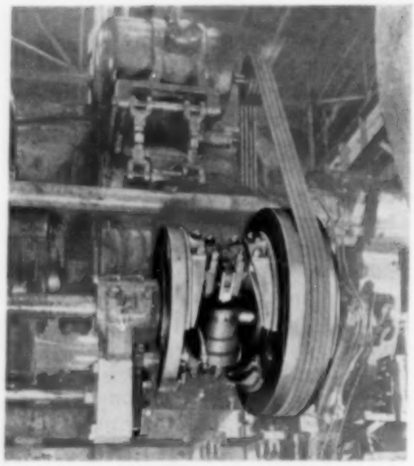
Industrial Notes

Shown in the accompanying illustration is the newest model bending machine recently announced by J. A. Richards Company. Known as the Big Brother Multiform Bender, it is designed to fabricate bus bars, brackets, fixtures, and numerous other metal parts. Examples of the work performed are shown at the base of the machine. It develops a bending pressure of approximately 10 tons through the medium of a compound toggle train actuated by an 8-inch pneumatic cylinder with a 10-inch stroke controlled by a 4-way Hannifin valve and using air at 90 to 100 psi. According to the manufacturer, air power was chosen in preference to hydraulic power because it was considered to be more efficient and to entail less service and maintenance cost. Two sizes are available for handling materials up to ¼x3 and ¼x4 inches, respectively.



Audible rather than visible warnings distinguish the Load Alarm from other signaling systems designed to detect transformer overloads. Installed within the latter, a buzzer functions when a fusible element with a predetermined melting point causes a circuit to close. The tone, which is amplified, is unmistakable, and prevents delay such as might occur with a visual alarm in calling the matter to the attention of the public utility. The thermal element is easily replaced after it has served its purpose. The device is made by the Line Material Company.

For surface finishing aluminum parts and sheet material, Diversey Corporation is offering a new alkaline etching compound called Aluminux. It comes in white granules and is mixed with water in working tanks maintained at a high temperature by steam coils. It is claimed that the solution will not form scale or sludge in the vat; produce a fine even etch that can be controlled by varying the concentration of the bath, its temperature, and time of immersion; and eliminate tool and die marks.



IN DRIVING POSITION

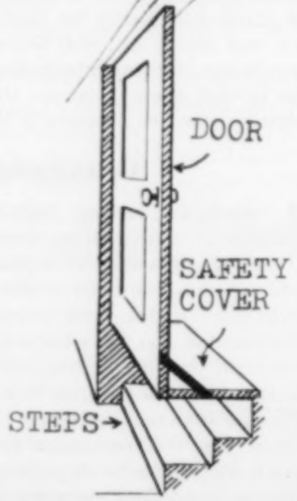
The air-powered clutch-and-brake unit on a multiple-station automatic-feed press used for blanking, forming, and trimming metal in an automobile plant.

For driving medium and heavy machinery such as presses, power shovels, oil rigs, marine drives, and rolling mills, Power Presses, Inc., is offering a new combination friction clutch and brake unit. It is air-powered and entirely controlled by a solenoid valve which admits compressed air to the clutch, engaging it. The brake is operated by preloaded springs. In case of current or air failure, the valve, which is provided with a spring return, immediately closes, causing the air in the clutch to escape to the atmosphere and the preloaded springs to disengage the clutch and engage the brake. Clutch and brake cannot be engaged simultaneously. A feature of the unit is its accessibility which, says the company, reduces maintenance costs by making it possible without dismounting it from the machine to change shoe and lining assemblies in minutes instead of hours, as well as to remove all wearing parts without the use of special tools. Further savings are effected, it is claimed, because wear is virtually limited to the linings, and disk scoring is prevented because rivet heads cannot come in contact with them. Disks are securely bolted in place and linings are positively withdrawn from contact with them, eliminating drag. The company has an exchange system for clutch and brake shoes so users need not stock spare parts in quantity.

Altered Door Averts Accidents

THE accompanying sketch illustrates a combination door and step cover designed by an engineer to eliminate the likelihood of broken legs or other bodily injury. Originally, the door swung toward the left, away from the stairs, leaving a dangerous opening in the room at the right into which a passerby might fall.

The full-length door was sawed off, its hinges were changed, and it was rehung so that it now swings into the room at the right. The horizontal member attached at the bottom covers the steps when the door is closed. The latter now moves through an arc of only 90°, but that occasions no inconvenience. Although unsightly, the alteration is definitely of value as a safety measure.

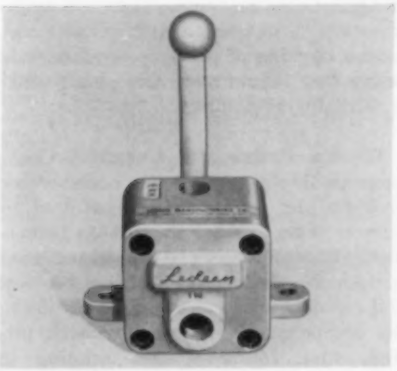


Aluminum jacketing only 0.006 inch thick is being offered by Childers Manufacturing Company for the protection especially of outdoor insulated lines at refineries, chemical plants, etc. It is ribbed for added strength, does not require forming, and is easy to cut and apply by means of aluminum strapping and seals, steel-metal screws, or a special tape. It is obtainable with a moisture-resistant backing for use with alkaline insulating materials. The sheathing is made in rolls 4 feet wide and 100 or 200 feet long.

Great Western Tools, Inc., has announced a redesigned Feedmaster, its pneumatic strip-stock feeder for use with plain, compound, or progressive dies. It is mounted on the die or the press for side, front, or back push or pull, and the stock passes through the unit's two heads, one stationary to prevent reverse movement and the other attached to the piston of a pneumatic cylinder. Air is supplied to the latter by a cam-operated valve, which is actuated by the press to feed stock at the desired time in the cycle. Improvements over the previous model include springs on the bar supports to absorb shock load, a clamping mechanism to hold the fixed head to the bar supports, and more gripping power in the movable head. The new Feedmaster is available in two sizes with maximum piston strokes of 6 and 12 inches and for stock widths of 8 and 18 inches. Operates at speeds up to 200 strokes per minute.

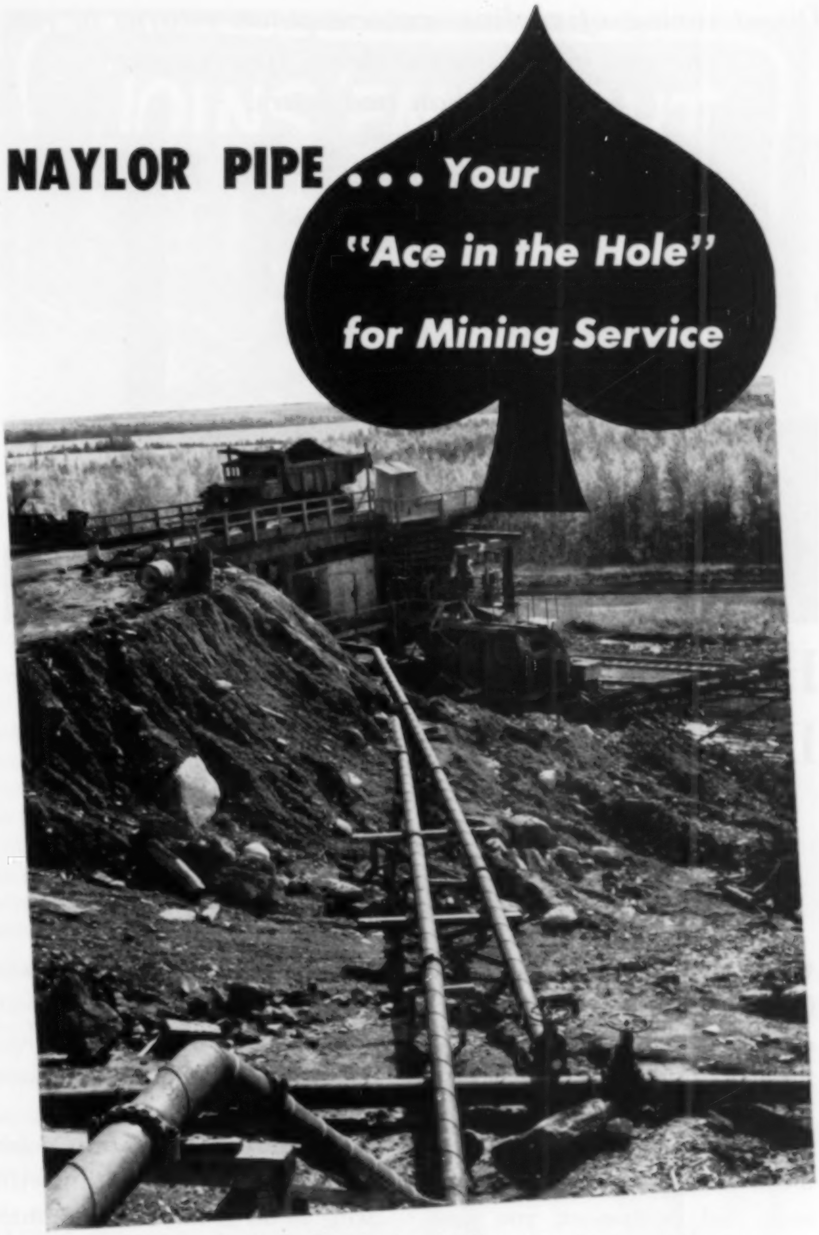
Vanadium can now be obtained in small quantities for fabrication from the Electro Metallurgical Division of Union Carbide & Carbon Corporation, New York, N. Y. The metal is said to average more than 99.8 percent vanadium and is supplied in the form of ingots, bars, sheets, foil, and even chips for remelting into ingots of special shapes and sizes.

For actuating air or hydraulic cylinders, Ledeen Manufacturing Company has recently introduced a line of valves of rotating-disk construction. Designed for hand, foot, or finger or solenoid operation, the three types are available in fourteen models for five different cycles and in six sizes. The first turns 45° each way from neutral; the second 15°; and the third is actuated by two poppets which are depressed about ⅛ inch and controlled by two small solenoids that require only momentary energizing. The unit shown is of the 4-way hand-operated type. Full details including circuit diagrams are contained in Bulletin 510 obtainable from the company at 1602 S. San Pedro Street, Los Angeles 15, Calif.



By means of a magnifying lens provided with clips, any incandescent lamp in the 25- to 100-watt range can be converted into a spotlight. It can be adjusted so as to concentrate the light at any point in desk, table, bench, or machine work. The lens is manufactured by the Light Intensifier Company, 1523 Crane Ave., Detroit 14, Mich.

Pneu-trol Devices, Inc., has announced a new time-delay switch for electric solenoid valves used to control air or hydraulic cylinders in a wide range of process and production operations,



For hydraulic lines, for high and low pressure air lines, for de-watering and drainage, for push-pull ventilating, for water supply and sludge lines—you can always depend on Naylor pipe.

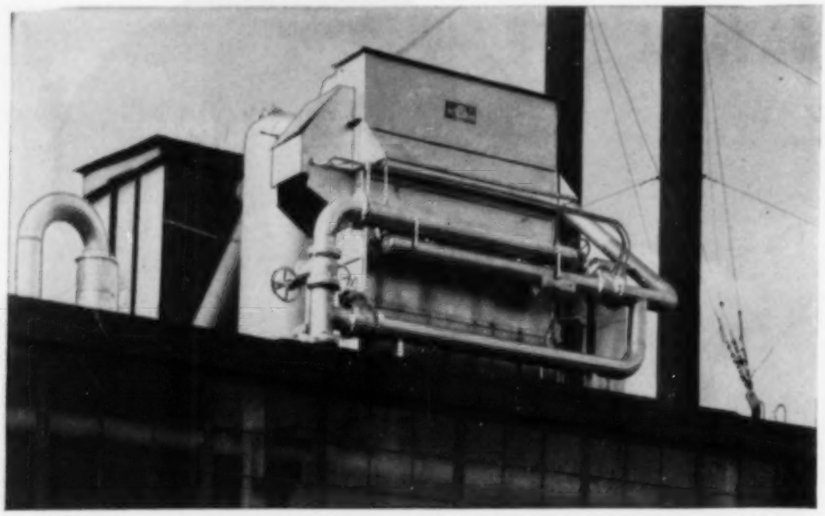
Its light weight makes it easier to handle and install, regardless of rough terrain. Its distinctive Lockseam Spiralweld structure gives it the strength and safety you require on the job. That's what makes Naylor different from ordinary light-weight pipe and why so many mining engineers regard it as their "ace in the hole" for piping jobs.

Sizes from 4″ to 30″ in diameter . . . Thickness from 14 to 7 gauge . . . all types of fittings, connections and fabrications. Write for new Bulletin No. 507.

NAYLOR PIPE

Naylor Pipe Company, 1245 E. 92nd St., Chicago 19, Ill.
New York Office, 350 Madison Avenue, New York 17, N.Y.

Direct saving of cooling water expense returns to you the cost of a Niagara Aero After Cooler in less than two years.



How to Get Drier Compressed Air:

It prevents many troubles and saves much expense

● NIAGARA AERO AFTER COOLER cools compressed air or gas below the temperature of the surrounding atmosphere. Therefore you get no further condensation in your lines. You save much in repairs to pneumatic tools and equipment; you save much interruption to production; you save water damage in paint spraying, in air cleaning, in any process where compressed air comes in contact with your materials or parts in manufacturing (sand blasting, for example).

Niagara Aero After Cooler uses evaporative cooling, saving 95% of your cooling water consumption. This saving quickly returns the cost of the equipment to the owner or makes extra cooling water available for other processes.

The Niagara Aero After Cooler produces compressed air with 30% to 50% less moisture than by ordinary cooling methods. Other Niagara equipment provides bone-dry air for processes requiring it.

If you have an air problem or a cooling problem, a Niagara engineer probably has an answer that will improve your process or save you operating or maintenance expense.

Write for Bulletin 98

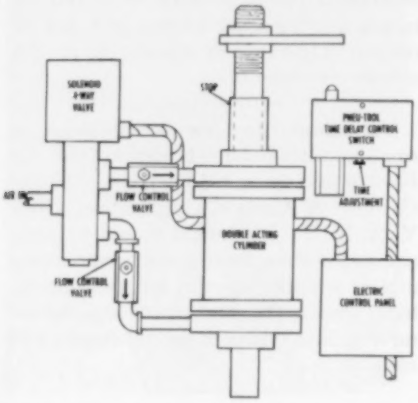
NIAGARA BLOWER COMPANY

Over 35 Years Service in Industrial Air Engineering

Dept. CA, 405 Lexington Ave. New York 17, N. Y.

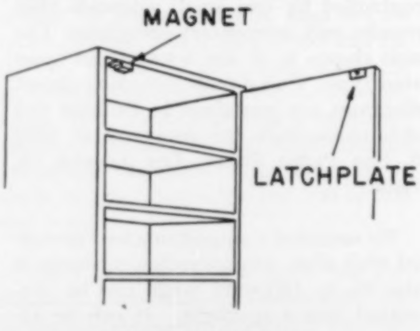
Experienced District Engineers in all Principal Cities

fixture loading and unloading, etc. The device has a time-dwell range of from ¼ to 10 seconds and is adjusted by turning a knurled screw. The switch automatically resets itself after functioning. Compact and small in size (3⅞x2⅜x1⅜ inches), it can be mounted near the mechanical stop without interfering with machine movement. The accompanying diagram shows a typical installation.



Instead of carrying a stock of multicolored electric wire, W. H. Brady Company suggests limiting the supply to one kind and color coding it as required with its Quik Label markers. They are made of cotton cloth treated with silicone and have a backing of pressure-sensitive adhesive that is said to adhere permanently without moistening.

Warren Refining & Chemical Company will analyze your boiler-water problem and compound a treatment to remove scale and to prevent its formation. Luminite, as the coagulant used is designated, possesses both chemical and colloidal properties and, according to the company, also serves to check pitting, rust, foaming, and priming in steam boilers.



LASTS A LIFETIME

This drawing shows how a revolutionary type of catch is installed on cupboard or other doors of metal or wood to keep them closed even though they may be warped or sagging. Called the Leco-Latch, it consists of a small but powerful permanent magnet that is attached to the closet and of a small special-steel plate that goes on the door. It is made by Laboratory Equipment Corporation, St. Joseph, Mich., and is distributed through lumber dealers.

Books and Industrial Literature

A revised edition of the *American Standard Abbreviations for Use on Drawings* has been published by the American Standards Association, 70 E. 45th Street, New York 17, N. Y. More than 200 changes have been made in the abbreviations contained in the original 1946 edition, and 40 new ones have been added. The committee that developed the standard was jointly sponsored by the American Institute of Electrical Engineers and the American Society of Mechanical Engineers. Copies are available from the publisher at $1 each.

Mechanical seals for rotary shafts of pumps or other equipment are dealt with in a bulletin prepared by The Garlock Packing Company, Palmyra, N. Y. The seals are made in several standard designs and in a suitable range of materials for various kinds of service. The bulletin is titled *Mechanical Seals for Rotary Shafts*.

Barco Manufacturing Company, 1801 Winnemac Avenue, Chicago 40, Ill., is distributing a new bulletin, No. 215, that describes its line of flexible ball joints for piping used for power, process, heating, chemical, or hydraulic services. The joints are furnished in twelve styles and in fifteen sizes from 1/4 inch to 12 inches.

Controlled Air Power describes cylinders and control systems developed by The Bellows Company, 222 West Market Street, Akron, Ohio, and their applications, especially in increasing and improving the performance of machine tools. The booklet also contains illustrations of typical examples of savings in money and manpower effected by them.

American Leather Belting Association, 41 Park Row, New York 7, N. Y., is distributing a manual, *Uni-Ball Drive*, that permits users of flat belts to choose the proper sizes, together with pulleys of the correct diameters, to transmit power from motors to machines. Data needed for selecting a belt-tension-controlling motor base of appropriate size for a given motor also are included.

Bulletin No. 85-A of Niagara Machine & Tool Works, 637 Northland Avenue, Buffalo 11, N. Y., describes a new power table for accommodating rotary-type sheet-metal forming machines. It is designed for such operations as beading, crimping, burring, turning, flanging, etc. The table has places for mounting four machines, and the driving motor is controlled by either of two foot-operated buttons on opposite sides.

Information on reagents used in treating copper ores by the flotation method is given in *Current Reagent Practice on Copper Ores*, a recent publication of the Mineral Dressing Division, American Cyanamid Company, 30 Rockefeller Plaza, New York 20, N.Y. Examples are cited to show how eighteen typical concentrating plants handle ores of various kinds.

Accessories designed for cleaning and drying compressed air automatically are described in Catalogue No. 501 available from Wilkerson Valve, Inc., Denver 9, Colo. The publication covers separators and drains for air lines; sump-, aftercooler-, and receiver-drains; air governors and filters; blowguns and fittings. Separators and drains are applicable to industrial air systems of all types and to air-brake systems on trucks, buses, and locomotives.

JOINS 'EM RIGHT
KEEPS 'EM TIGHT

"VIC"
VICTAULIC
VICTAULIC
Sizes—3/4" through 60"

The **COMPLETE** Victaulic System is the **EASIEST WAY TO MAKE ENDS MEET!** Victaulic offers a complete line of Full-Flow Elbows, Tees and other fittings, all carefully designed for free-flowing efficiency and leak-tight dependability.

Join 'em right – the Victaulic way – and you'll be sure of easy, quick hook-ups. Pipe ends are joined by a simple two-bolt coupling. A speed or T-wrench is the only tool required. **AND** Victaulic Couplings keep 'em tight ... pipe joints stay positive-locked, leak-proof. Victaulic Couplings are designed to stand up under extreme pressure, vacuum, or strain conditions.

Preparing those pipe ends is a cinch the Victaulic way..."Vic-Groover" grooves 'em automatically in a jiffy, more than twice as fast as a conventional pipe threader!

SAVE time, work, and dollars on your piping construction and maintenance. **JOIN UP** with Victaulic.

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The easiest way to make ends meet
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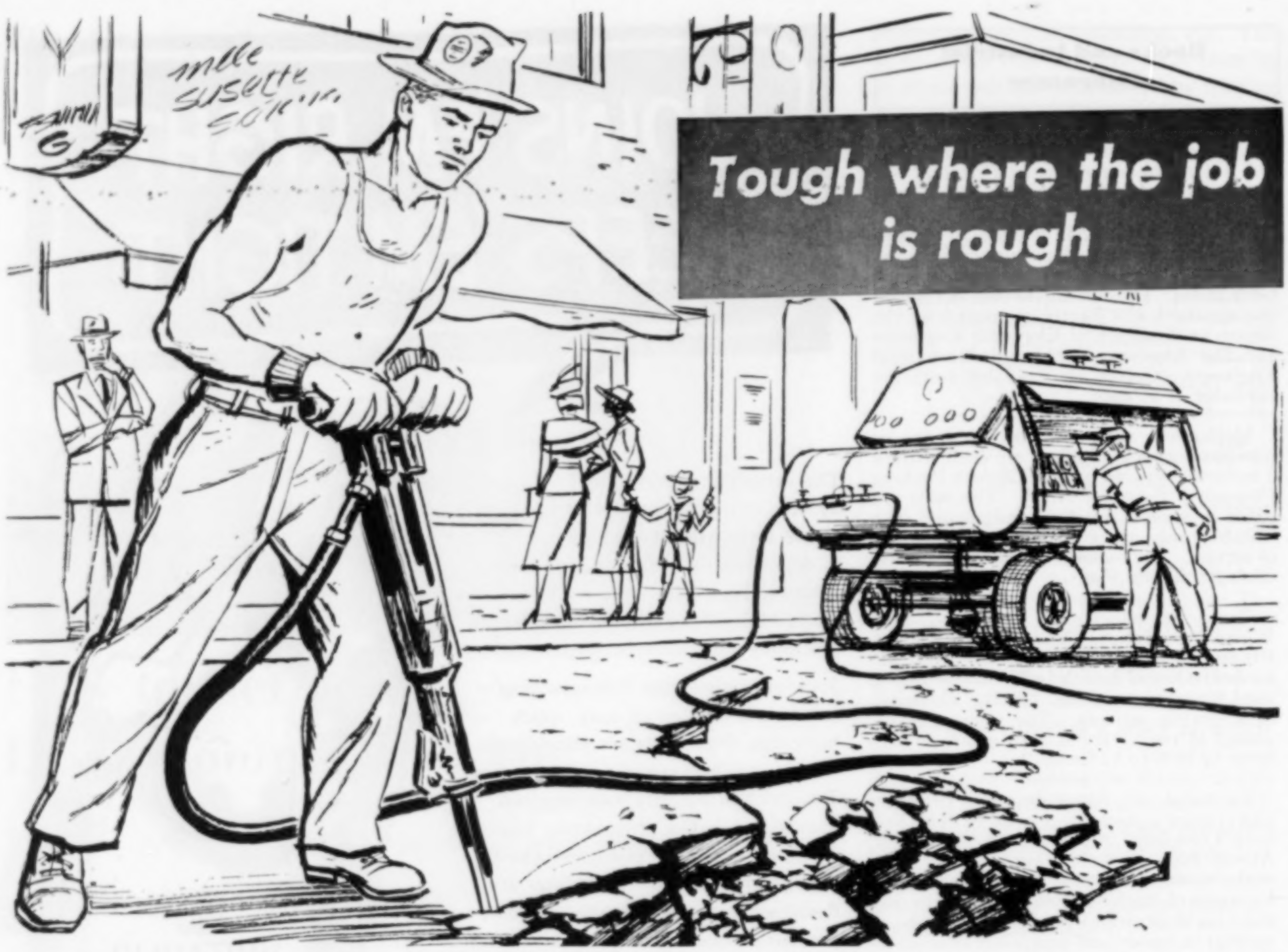
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Tough where the job is rough

Air hose with cover and tube of NEOPRENE is built for long, trouble-free service on road work

Blazing sunlight, razor-edged chunks of broken pavement, hot oil in the line . . . that combination could mean a short life for air hose. But not this kind! For it's protected inside and out with tough, durable neoprene.

The cover of neoprene withstands exposure to sunlight, ozone, heat and oil . . . doesn't crack or soften. It *stays* tough and durable—resists cutting and chipping—continues to protect the fabric reinforcement long after adverse conditions would have weakened an ordinary hose cover to the failing point.

The neoprene tube won't go to pieces when exposed to lubricating oil in the air stream. So no crumbled particles can be carried along to clog vital parts in the tool. Neoprene remains tough . . . delivers long, leak-proof service under the worst conditions.

Wherever air power is used . . . where operating conditions are toughest . . . you'll find hose made with cover and tube of Du Pont neoprene delivering long-lasting, trouble-free service.

NEOPRENE PREVENTS TROUBLE LIKE THIS!

Jackhammer, partially dismantled, shows accumulation of disintegrated hose which has almost clogged up air ports in the valve and rifle bar assembly.

NEOPRENE

The rubber made by Du Pont since 1932

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REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

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for Safety and Long-Time Service

For 2000, 3000 and 6000 pounds service — Sizes 1/8" to 6"

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For schedules 40, 80 and 160 pipe — Sizes 1/8" to 4"

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Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog F-9 will aid you in their selection and proper application.

Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy in steam plants, petroleum refineries, chemical plants and related industries.

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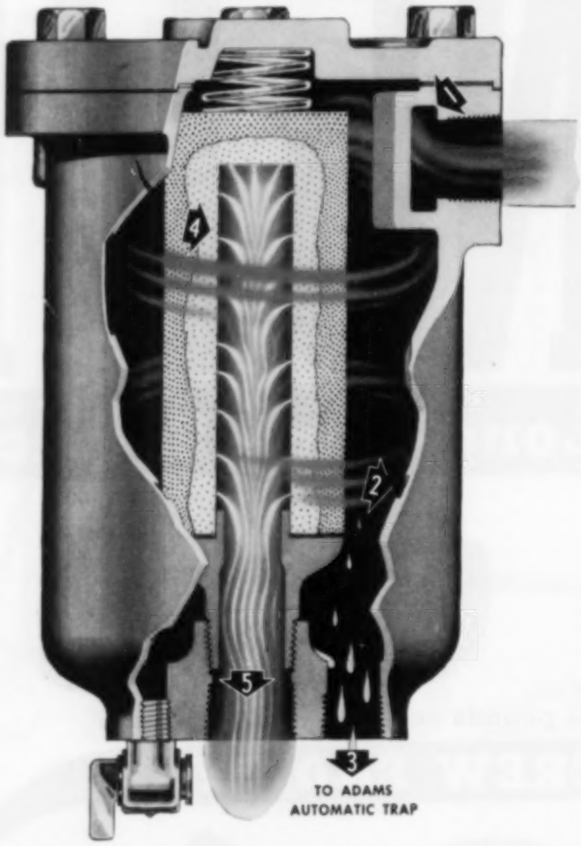
Vogt DROP FORGED STEEL FITTINGS

ADAMS *has both* *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5
3
TO ADAMS AUTOMATIC TRAP

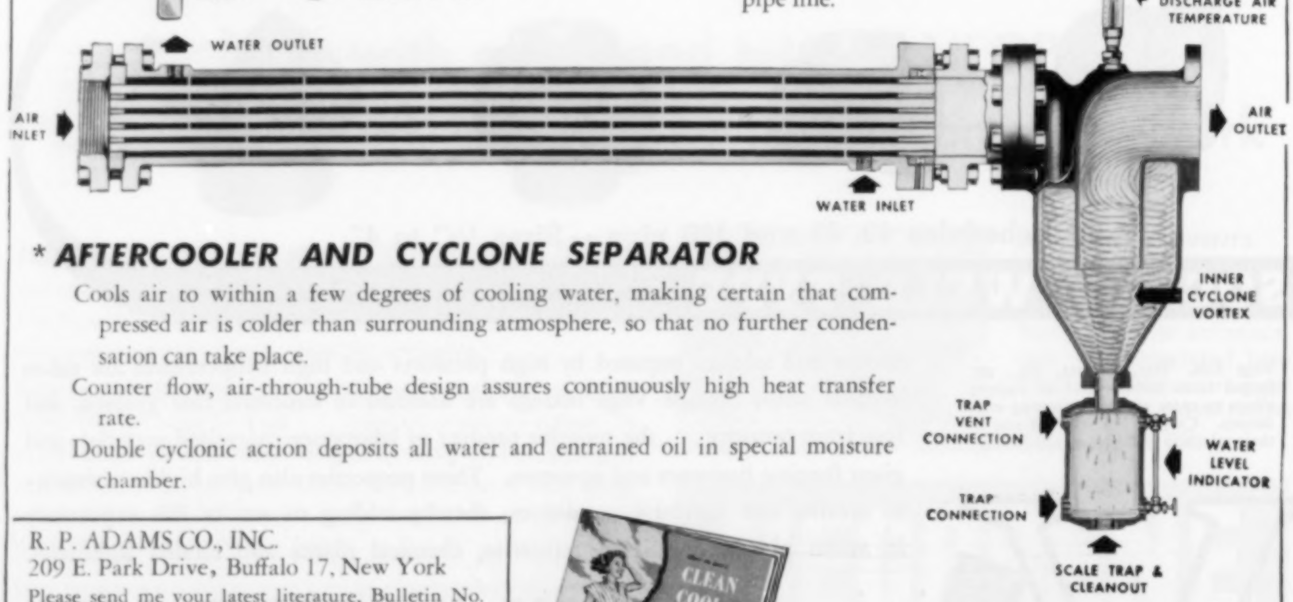
— BOTH ANSWERS TO THE PROBLEM OF KEEPING WATER, WATER VAPOR, OIL AND DIRT OUT OF COMPRESSED AIR LINES

There's no *one* answer to this problem! The most expensive aftercooler you can buy will not remove scale that is picked up in the distribution lines. The most expensive air filter you can buy cannot guarantee removal of water vapor until it has been condensed by cooling. That's why Adams makes both.

* PORO-STONE AIR FILTER

1. Centrifugal separation of dirt and liquids.
2. Drainage to trap directed by vertical cast-in slots.
3. Continuous, fully automatic trap action.
4. Rapid diffusion and filtration through permanent, cleanable Poro-Stone.
5. Clean, dry air at practically unchanged pressure. Standard, stocked sizes handle from 10 to 700 cfm.

Easily installed in either vertical or horizontal pipe line.


THERMOMETER TO INDICATE DISCHARGE AIR TEMPERATURE
WATER OUTLET
AIR INLET
AIR OUTLET
WATER INLET
INNER CYCLONE VORTEX
TRAP VENT CONNECTION
WATER LEVEL INDICATOR
TRAP CONNECTION
SCALE TRAP & CLEANOUT

* AFTERCOOLER AND CYCLONE SEPARATOR

Cools air to within a few degrees of cooling water, making certain that compressed air is colder than surrounding atmosphere, so that no further condensation can take place.

Counter flow, air-through-tube design assures continuously high heat transfer rate.

Double cyclonic action deposits all water and entrained oil in special moisture chamber.

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209 E. Park Drive, Buffalo 17, New York

Please send me your latest literature, Bulletin No. 176 on BOTH the Poro-Stone air filter and the Adams Aftercooler — Cyclone Separator.

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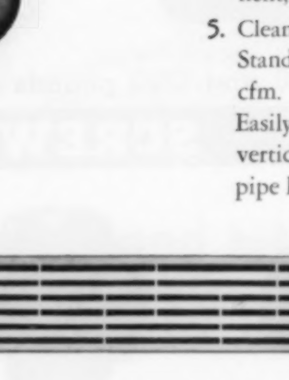
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FOR YOUR PROFIT'S SAKE — FIND OUT ABOUT BOTH

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3 REASONS WHY THE NEW COOK 124 ANTI-FLUTTER RING HAS ELIMINATED RING BREAKAGE IN SO MANY ENGINES!

1. It Eliminates the Cause of Ring Breakage

The cause of ring breakage in most engines is ring flutter. Ring flutter results from the inability of standard rings to withstand the combustion shock that starts with ignition — molecular fatigue sets in and the ring fails. The pressure that causes ordinary rings to collapse actually holds the Cook 124 tight against the cylinder, because it is allowed to enter the clearance in back of the ring, through the flutes, and keep the ring against the cylinder. This simple "pressure-energizing" principle is a big factor in the success of the ring.

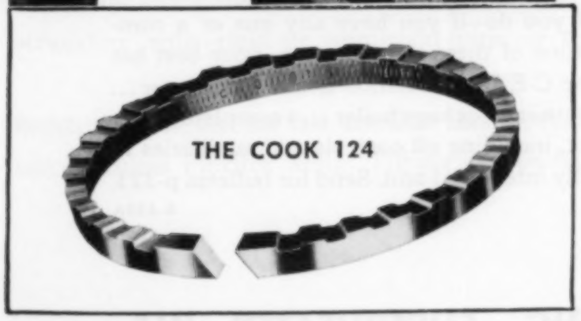
2. It's Made of a Proven Wear-Resisting Material

The anti-flutter feature of the Cook 124 ring has made it possible to use a material of proven wear resistance — Cook Graphitic Iron — as contrasted with ordinary rings made of high modulus materials.

3. It's Precision Engineered

Every Cook ring has to meet exacting standards of quality and precision. The Cook 124 is no exception. The flutes are developed on a single purpose tool, designed for this single operation, which materially reduces the cost and maintains the ring's equilibrium. If you are troubled with ring breakage — get the full story — Write today.

* * * *



C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

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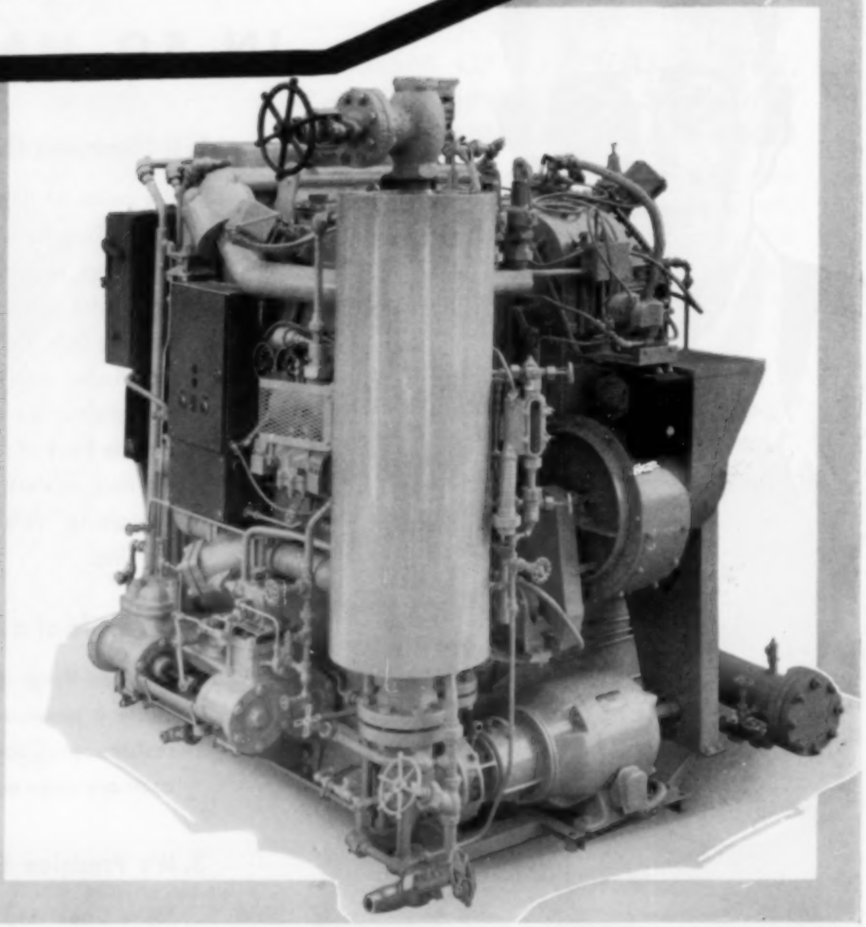
GRAPHITIC IRON
PISTON RINGS

. . . SEALING PRESSURES SINCE 1888 . . .

Not a Package Boiler—but a PACKAGED STEAM PLANT

Compact -Reliable -fully Automatic



C-E RE-CIRCULATION STEAM GENERATOR

Unit shown at the right is the 6,000 lb of steam per hr size; occupies a space 6′-11″ long x 5′-5″ wide x 6′-11″ high. Other standard sizes — 2800 and 4000 lb of steam per hr.

Do you need steam . . .

. . . for heating, processing or both – in unit capacities up to 6,000 pounds per hour – for pressure up to 300 psi?

. . . in remote locations involving the expense of installing and maintaining long insulated pipe lines?

. . . for intermittent requirements—a few hours each day or week?

. . . for an occasional load which may exceed the capacity of existing boilers?

. . . for a highly fluctuating load which involves sudden heavy demands?

. . . with completely automatic operation; with a minimum of attention necessary?

. . . at maximum output from minimum space?

If you do—if you have any one or a combination of these requirements—your best bet is the C-E Re-circulation Steam Generator . . . more than a package boiler . . . a complete steam plant, including all controls and auxiliaries in a fully integrated unit. Send for bulletin p-323.

B-458A

C·E

COMBUSTION ENGINEERING – SUPERHEATER, INC.

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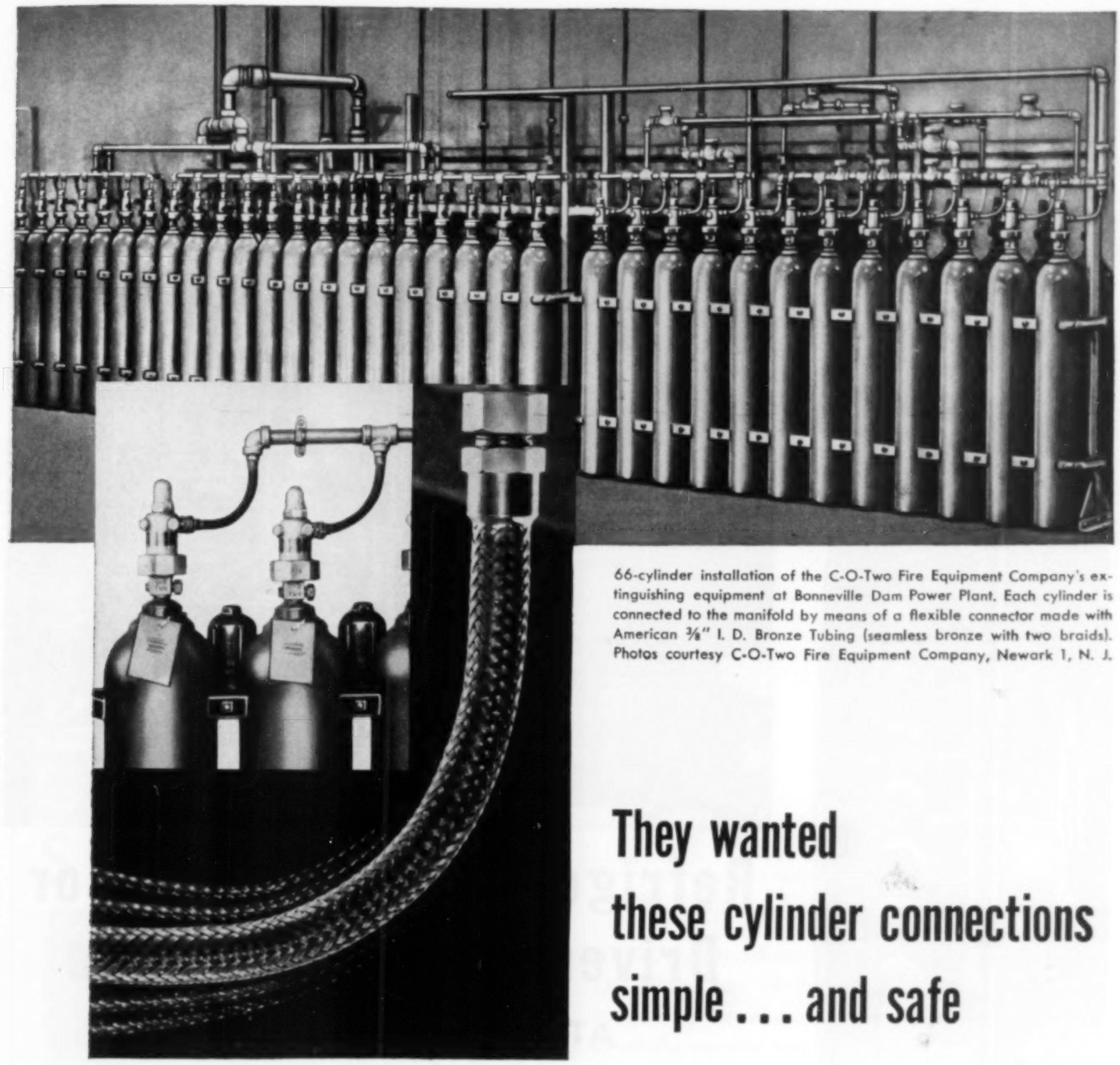
ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



66-cylinder installation of the C-O-Two Fire Equipment Company's extinguishing equipment at Bonneville Dam Power Plant. Each cylinder is connected to the manifold by means of a flexible connector made with American ⅜" I. D. Bronze Tubing (seamless bronze with two braids). Photos courtesy C-O-Two Fire Equipment Company, Newark 1, N. J.

They wanted these cylinder connections simple . . . and safe

So they used American Seamless Flexible Metal Tubing for the 66 manifold connectors in this installation. Couplings swing freely and accurately into line. No struggling with rigid or semi-rigid pipe or tube.

Resists corrosion, heat and cold; minimizes vibration. American Seamless Flexible Metal Tubing can be flexed thousands of times with no danger of failure—carries thousands of pounds pressure safely. For flexible metal hose or tubing designed for use with almost any gas, vapor, liquid, or even semi-solid, consult The American Brass Company, American Metal Hose Branch, Waterbury 20, Connecticut. In Canada: The Canadian Fairbanks-Morse Company, Ltd.

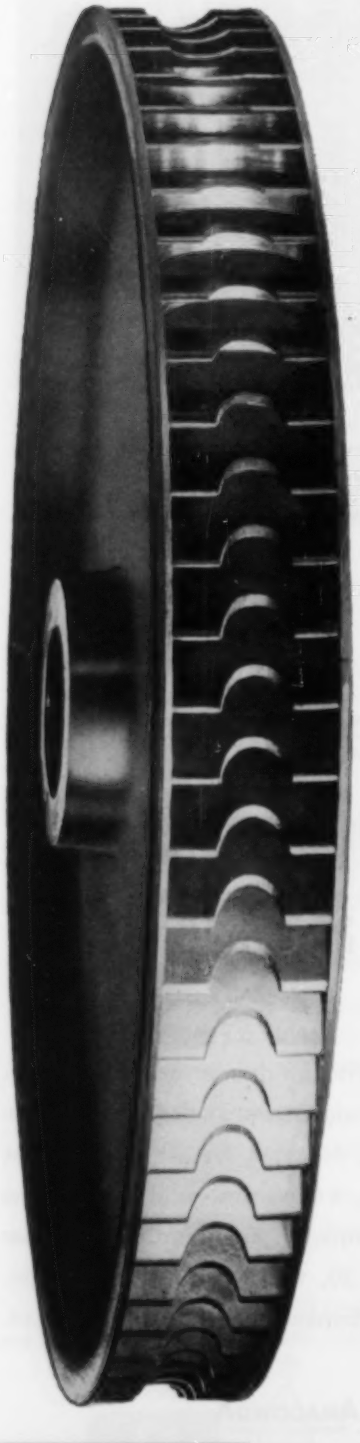
49295

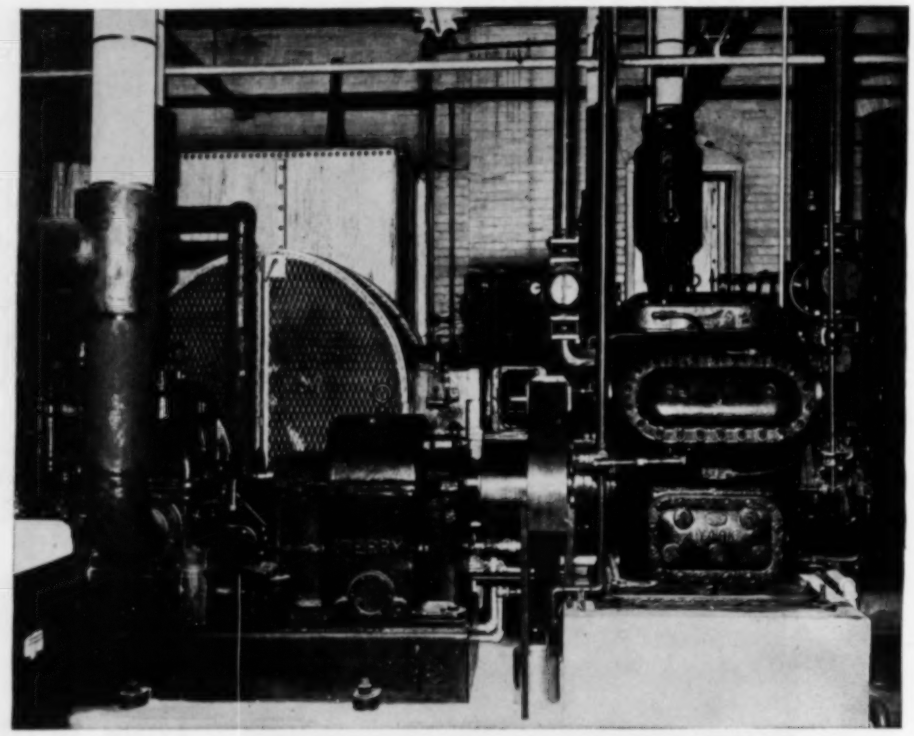
ANACONDA
from mine to consumer

wherever connectors must move . . . American

FLEXIBLE METAL HOSE AND TUBING

the Terry Turbine





Refrigeration Compressor Driven By Terry Turbine

AT HAMPDEN BREWERY

This 150 hp Terry Turbine — at the Willimansett, Mass. plant of the Hampden Brewing Co. — operates at 3800 rpm with a gear reducing it to 720 rpm. It is coupled to a 6 cylinder reciprocating compressor.

The installation is running on steam conditions of 120 psi — 0° superheat, and the steam to the turbine is automatically throttled to maintain a constant 30 psi back pressure for process and heating. The installation was developed by Fred Ophuls & Associates Consulting Engineers.

Get more information on the wide range line of Terry Turbines from your local District Representative. There's no obligation for a complete discussion of your specific requirements. Also send for Bulletin S-143 that gives full details.

THE TERRY STEAM TURBINE CO.

TERRY SQUARE, HARTFORD 1, CONN.

TT-1186

Terry

MULTI-STAGE TURBINE

SOLID WHEEL TURBINE

PUMP CONTROL
PRESSURE, FLOAT AND TEMPERATURE SWITCHES

Send FOR THIS NEW CATALOG

Square D offers a wide range of pressure, float and vacuum switches for practically all sizes of water pumps, condensate pumps, vacuum pumps, air compressors, machine tools and other machinery involving pneumatic or hydraulic systems. Send for your free copy of Pump Control Catalog, with illustrations and specifications.

Square D Company, 4041 N. Richards St., Milwaukee 12, Wis.

Ask Your Electrical Distributor for Square D Products

SQUARE D COMPANY

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SAUERMAN

Power Drag Scrapers

Picture shows a small Sauerman Crescent Scraper (1/3 cu. yd.) reclaiming slaked lime from a huge waste pile to a portable processing plant. The scraper cuts through the outer crust and moves about 300 tons of the sticky material a day.

A Sauerman Scraper can reach across a pit, pond, bank or stockpile and move material at high speed from one point to another anywhere within its wide radius of operation. Any mechanic can operate it. Upkeep is simple. Sturdy construction for long service. Bucket sizes from 1/3 to 15 cu. yd.; spans range up to 1000 ft.

These machines are backed by over 40 years of experience in designing this type of equipment. Whether it is an installation to handle a hundred tons, or many thousand tons per day, it will be efficient, economical and easily operated by one man.

Write for our new Scraper Catalog

SAUERMAN BROS., INC.
548 S. Clinton St., Chicago 7

Here's what you get

with NUGENT FILTERS for fuel and lube oil

NUGENT
DRAIN

FIG. 1280A #4L

- √ More Filtering area
- √ More effective filtering
- √ Choice of full flow or by pass filtering
- √ Choice of inexpensive recharges
- √ Simple piping
- √ Capacities to meet every need

NUGENT Absorbent Type Fuel and Lubricating Oil Filters pay off for you in many ways—they conserve your oil . . . they extend the life and improve the service you get from your equipment . . . they are available at the lowest over-all cost per square inch of filtering area. Add to these such additional advantages as ease of installation, economy of recharging and high filtering efficiency and you'll see why we say you can't afford to be without Nugent Filters.

Write today for descriptive literature outlining the nature of your filtering problems. It's the first important step towards big savings.

NUGENT TRADE MARK

Wm. W. Nugent & Co., Inc.
422 N. Hermitage Ave. CHICAGO 22, ILLINOIS

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

Established 1897

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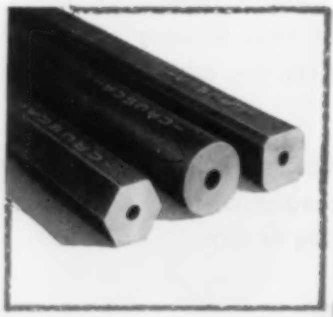
DRILLING OUT HARD ROCK

ANOTHER JOB for HOLLOW DRILL STEEL



When you're up against a tough, hard-rock drilling operation, set up your drills with Crucible Hollow Drill Steel. This quality steel is built to take the punishment of around-the-clock operation of modern, high air-pressure rock drills. And you have the assurance of minimum breakage . . . and an end to loss of expensive bits.

That's because *every* lot of Crucible Hollow Drill Steel is *pretested* before it gets to you. What's more, Crucible Hollow Drill Steel is backed by the experience of engineers and metallurgists who are drill steel specialists. They work right on the job with you . . . if you need them.

You get all these extras when you do business with Crucible. Our metallurgists and drill steel experts can help you with these "special" jobs that take something different in drill steels. CRUCIBLE STEEL COMPANY OF AMERICA, General Sales and Operating Offices, Oliver Building, Pittsburgh, Pennsylvania.

CRUCIBLE first name in special purpose steels

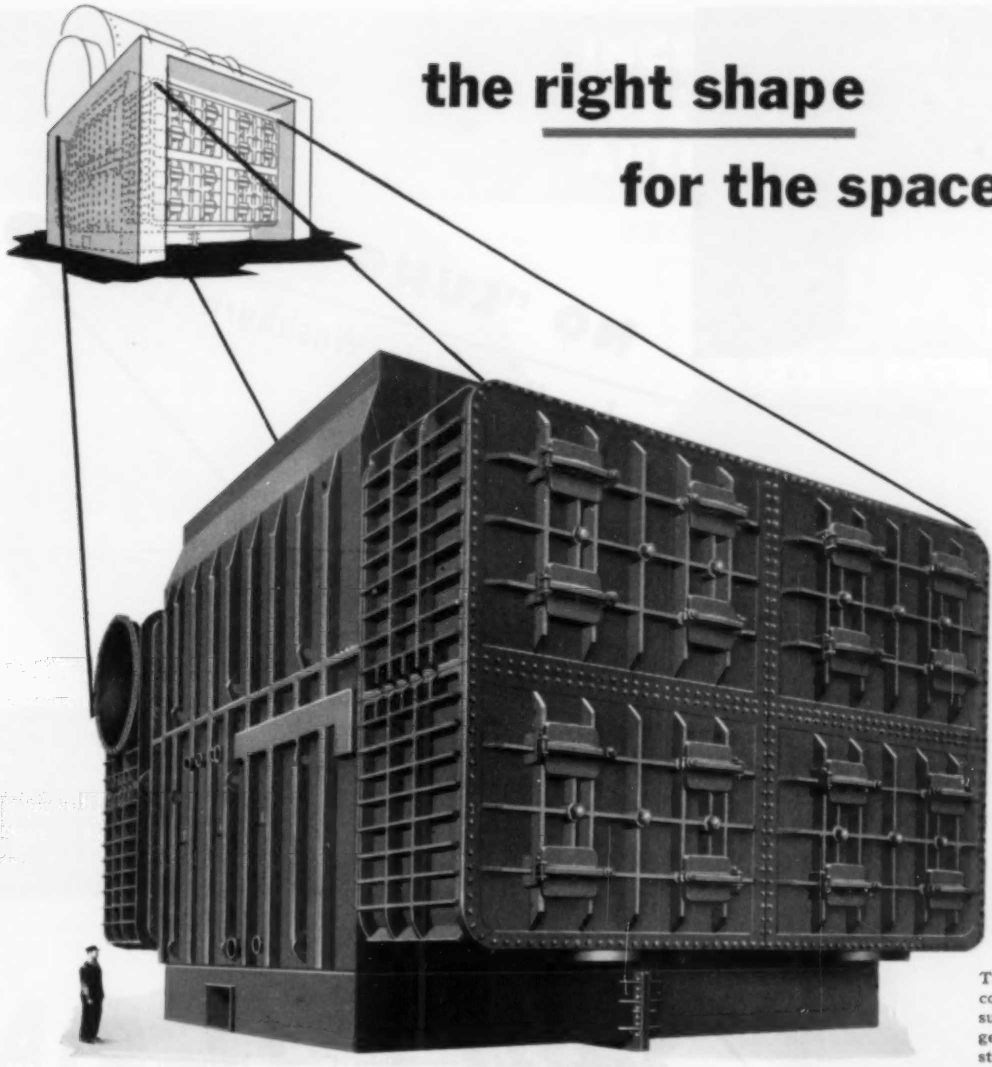
51 *years of Fine steelmaking*

HOLLOW DRILL STEEL

HIGH SPEED • TOOL • STAINLESS • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

the right shape

for the space available



This giant Rectangular Condenser, containing 90,000 sq ft of cooling surface, serves a 150,000 kw turbogenerator at a mid-western central station. The compactness of the I-R design made it possible to fit the cube-shaped space available.

that's one of the reasons why

I-R RECTANGULAR CONDENSERS

give you so much more kw *per cubic foot of available space*

Waste space has no place in a modern steam plant—particularly in the crowded quarters below the main turbine floor. And with Ingersoll-Rand Rectangular Condensers, you use all of the available space *most efficiently*—for two important reasons.

First—the compact, rectangular condenser shell is designed to *fit the rectangular space* beneath the turbine.

Second—these Rectangular Condensers have the same *high-heat-transfer design* that have made Ingersoll-Rand's condensers the standard of space-saving economy since they were introduced in 1922. This design, pioneered by I-R, provides positive control of steam flow through a low-friction-loss tube nest, eliminating "drone" surface and making all tubes work at peak condensing efficiency.

I-R Rectangular Condensers also cut installation time and expense. For they are completely assembled and tested in the factory . . . then shipped either in one piece or in flanged sections that can be bolted together without field fitting or strength welding.

These compact rectangular units were first introduced in 1946 to meet the increased demand for space-saving condensers. They are now serving, or being built for, more than 5 million kw of generating capacity. Your Ingersoll-Rand representative will gladly discuss this and other new developments in the power field with you.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

586-4

COMPRESSORS — AIR TOOLS — ROCK DRILLS — TURBO-BLOWERS — CONDENSERS — CENTRIFUGAL PUMPS — DIESEL AND GAS ENGINES

WASHBURN TUNNEL

NO "LUNG SPOTS"

for Houston's Washburn Tunnel

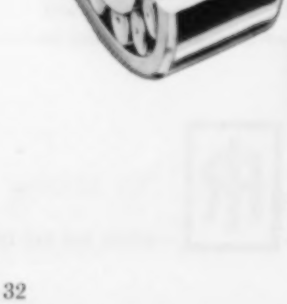
... thanks
to
Westinghouse
Sturtevant
fans

bearings by SKF

Slicing under the Ship Canal, Houston's Washburn Tunnel is guaranteed abundant fresh air, regardless of heavy traffic, thanks to the last word in engineered ventilation.

Three huge Westinghouse-Sturtevant Fans, regulated by automatic electronic controls, supply a complete change of air every two minutes. They have a maximum capacity of 760,000 CFM . . . and friction, need for lubrication and inspection are held to the minimum by SKF Spherical Roller Bearings. It is because of a well-earned reputation for dependability, because of their self-aligning properties and their ability to deliver continuous trouble-free service under adverse conditions that SKF Bearings have been specified for most of the country's major tunnel-fan installations.

7213



8 REASONS
WHY SKF
IS PREFERRED
BY ALL INDUSTRY

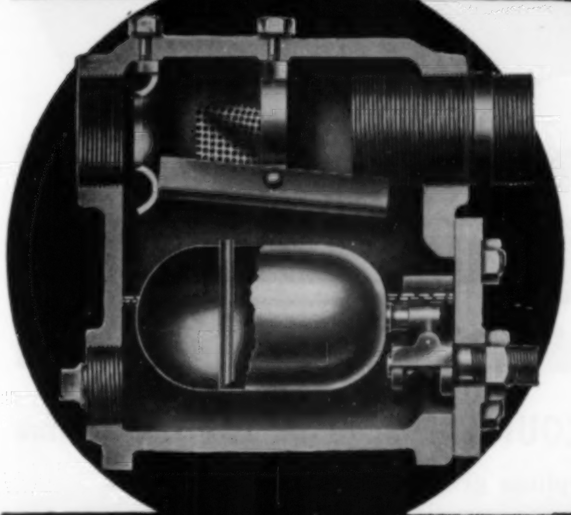
- integrity
- craftsmanship
- metallurgy
- tolerance control
- surface finish
- product uniformity
- engineering service
- field service

SKF
BALL AND ROLLER BEARINGS

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.
—manufacturers of SKF *and* HESS-BRIGHT *bearings.*

DRI AIR MAY BE INSTALLED BY SUSPENDING IT FROM THE PIPING WITHOUT ANY OTHER SUPPORT.

INCREASED PNEUMATIC EFFICIENCY WITH THIS AUTOMATIC SEPARATOR



PROTECT EQUIPMENT WITH

DRIAIR

SEPARATES • COLLECTS • DELIVERS

• DriAir separates and automatically ejects the condensed water and oil from compressed air lines, collects pipe scale and rust, delivers clean dry air to tools and other pneumatic equipment. This promotes better lubrication, reduces wear, increases life of tools and produces greater output. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent.

A TYPICAL INSTALLATION SHOWING DRI AIR STANDING ON A CONCRETE FLOOR NEXT TO THE WALL.

WRITE FOR BULLETIN DA WHICH FULLY DESCRIBES THE CONSTRUCTION AND OPERATION OF THE DRIAIR.

NEW JERSEY METER CO.

"SPECIALISTS IN COMPRESSED AIR DEVICES"

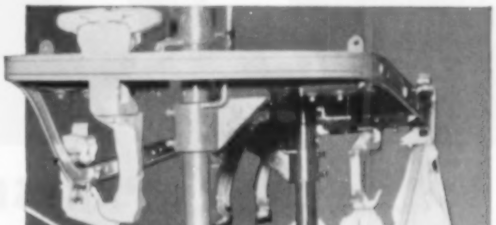
PLAINFIELD, NEW JERSEY

AIR-LIFT LIGHTENS LOAD for Laundry Workers...

NOPAK Air Cylinder

Reduces Fatigue, Speeds Production, Cuts Costs!

By proper application of a NOPAK Model E Air Cylinder, the National Marking Machine Co. has made its Damp Net Lift a real labor-saving device. It makes the former heavy task of handling damp bundles light, quick and simple; does away with "back-breaking" labor, speeds up work, reduces shakeout costs . . . The proper application of NOPAK Valves and Cylinders can improve the performance of equipment that you build or use . . . for production, maintenance, or material handling.



National Damp-Net Lift powered by NOPAK Model "E" Air Cylinder.

GALLAND-HENNING MFG. CO., 2759 S. 31st Street, Milwaukee 46, Wis.

Write for Bulletin SW-1 or refer to Sweet's File for Product Designers.

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Representatives in Principal Cities

NOPAK

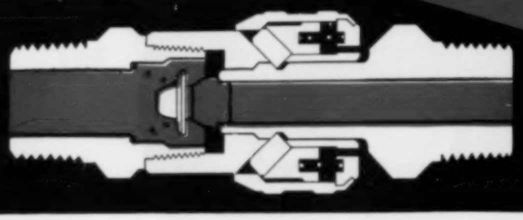
VALVES AND CYLINDERS

DESIGNED for AIR and HYDRAULIC SERVICE

A 5873-½H

HANSEN QUICK CONNECTIVE SHUT-OFF COUPLINGS

HYDRAULIC • PNEUMATIC

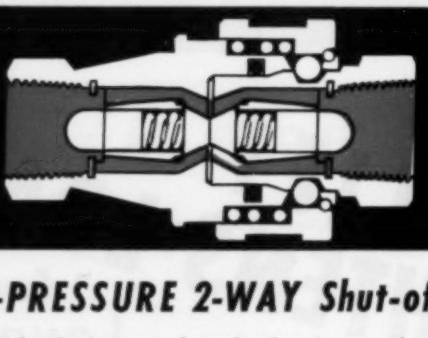


HANSEN *PUSH*-TITE COUPLING *Shuts off one side of line*

Hansen Push-Tite Couplings give you quick connection and disconnection, with instant automatic flow or shut-off. To connect coupling, and open line to flow of fluid, you merely push plug into socket. To disconnect, a slight pull on sleeve releases plug and shuts off supply end of line. Free swiveling plug prevents hose kinks.

HANSEN PUSH-TITE COUPLING

Cross-section at upper right shows flow through coupling when connected.



HANSEN *HIGH-PRESSURE 2-WAY Shut-off* COUPLING

To connect, merely pull back sleeve and push plug into socket. Identical torpedo type valves permit free flow of gas or liquid through coupling. To disconnect, just pull back sleeve—coupling immediately disconnects, valves automatically and instantly seal both ends of line. Can be mounted to disconnect automatically where fluid lines may be subject to sudden, damaging strain.

HANSEN SERIES HK

Shuts off both ends of line when disconnected.

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QUICK CONNECTIVE FLUID LINE COUPLINGS

AIR • OIL • GREASE • HYDRAULIC FLUIDS • REFRIGERANTS
VACUUM • STEAM • OXYGEN • ACETYLENE • GASOLINE
COOLANTS • WATER

HOSE CLAMPS • HOSE CLAMP PLUGS
HOSE CLAMP SOCKETS • HOSE CLAMP COUPLINGS

Write for Catalog giving descriptions and sizes of complete Hansen line of straight through and shut-off couplings for hydraulic and pneumatic connections.

THE HANSEN MANUFACTURING COMPANY

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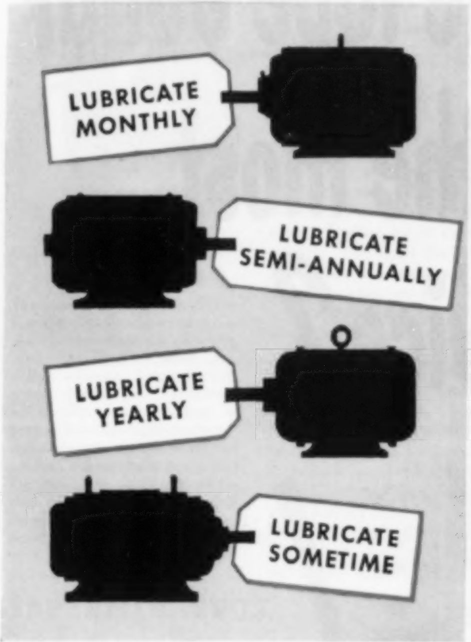
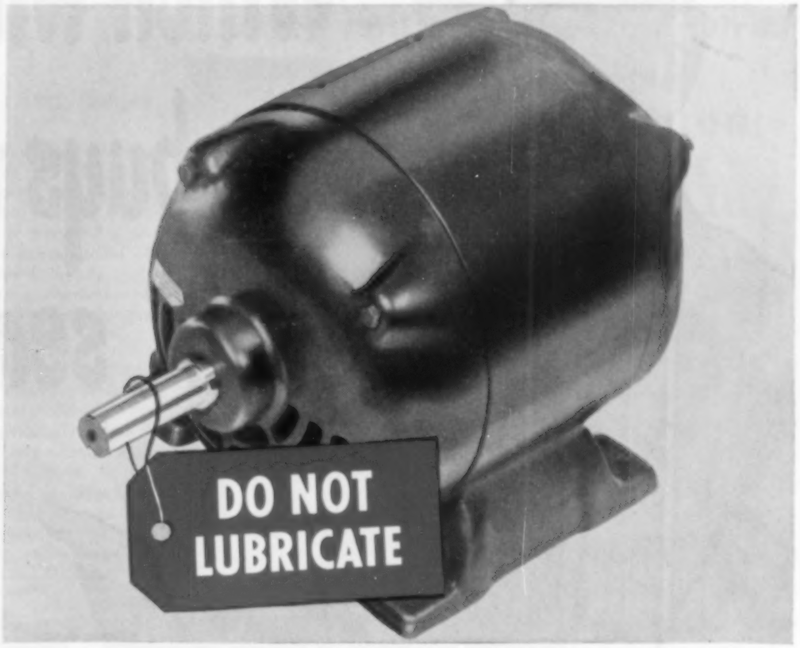
YOU CAN BE SURE.. IF IT'S
Westinghouse





Why take a chance with "Once-in-a-while" lubrication?

Why fuss with motors that require lubrication "every so often?" Whether it's monthly, yearly, every two or three years, or just an indefinite "sometime," it is as much trouble remembering when to lubricate, as it is to do the lubricating. And it certainly isn't a very good way of making sure bearings get proper greasing attention.

There *is* one way to be *sure*. That's with Life-Line motors. Lubrication is *positive*. Bearings are pre-lubricated and factory-sealed. *No* further lubrication is required!

This is the modern way of lubricating motors. Development of special lubricants, up-to-date manufacturing methods and special seals have made it possible.

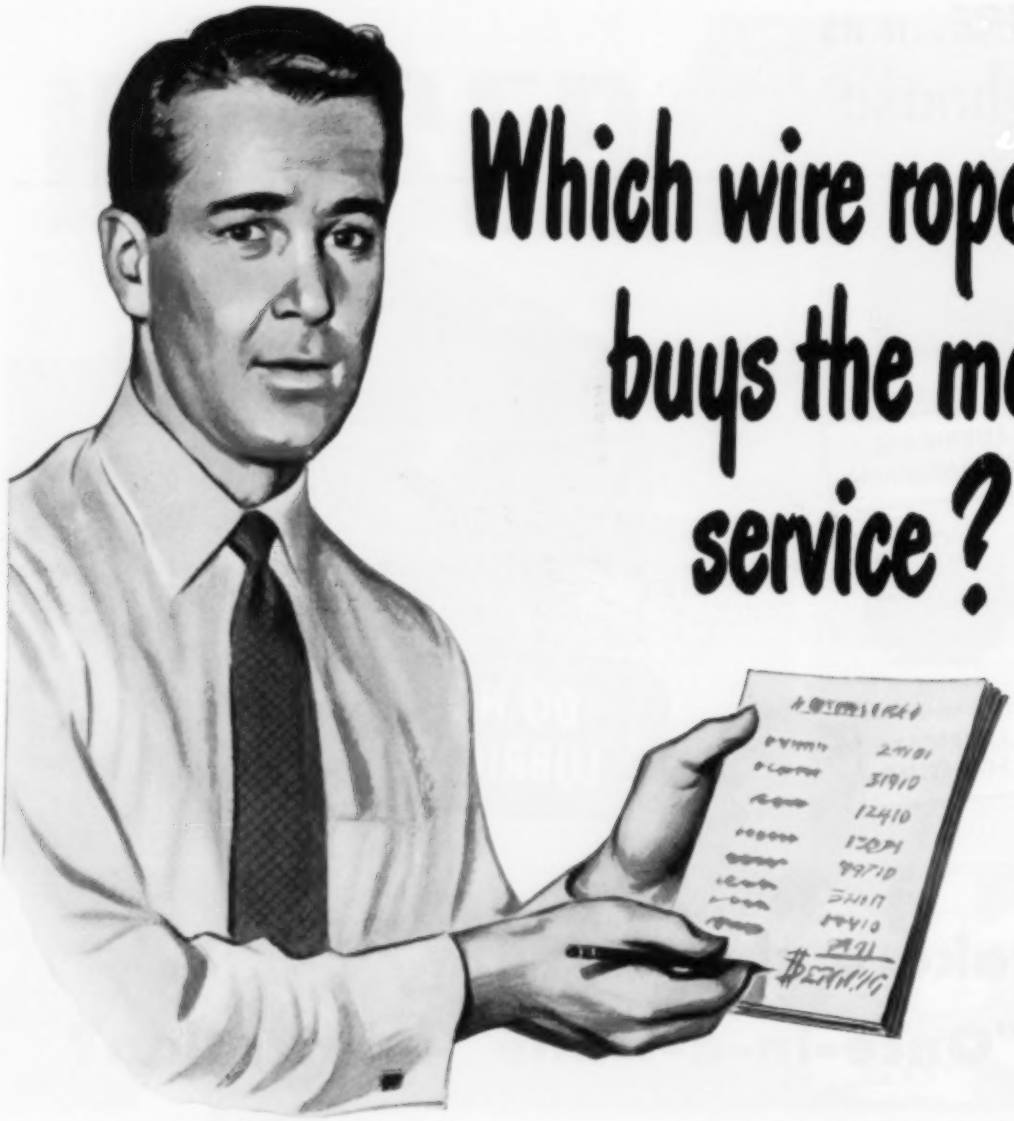
Records of nearly half a million motors, operating in every type of industry, indicate that prelubricated bearings offer: an average saving of $2.70 yearly per motor . . . 41% fewer motor outages due to faulty lubrication . . . complete freedom from lubrication attention.

Today, periodic lubrication is a costly nuisance. So why take a chance with it when Life-Line offers positive lubrication at no extra cost. See for yourself. Ask your Westinghouse representative for a copy of "Facts on Pre-Lubricated Bearings," B-4378, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-21559

— If you figure LIFE-COSTS . . . you'll figure LIFE-LINE —

Westinghouse
Life-Line
Motors
INDUSTRY'S LEADING MOTOR



Which wire rope dollar buys the most service?

Isn't it true that when you purchase wire rope, you're actually buying service? Buying what the wire rope will do for you? Buying units of work?

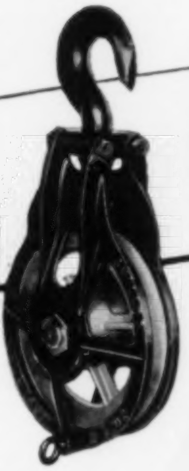
The rope dollar that buys the most units of work has been wisely spent. Can you tell which brand of rope is giving you the most for your money? There are many users who can—by keeping records of wire-rope performance. They know what constitutes good, average service in terms of ton-miles, yards of rock moved, etc. When a certain brand gives better-than-average service over a period of years, they know they're getting a big return on the dollars spent for that brand.

Their figures prove it. That's why Bethlehem urges the keeping of records—records that show rope costs per unit of work. For we feel that in any such comparisons, Bethlehem rope will stand out from the crowd . . . in a way that will please the user's pocketbook.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM
WIRE ROPE
BETHLEHEM STEEL

LET YOUR RECORDS TELL YOU!



SAUERMAN DUROLITE WIRE ROPE BLOCKS

run smoother . . . last longer

The purchasing agent of a large mining company using hundreds of wire rope blocks in underground operations, bought his first Durolite Block only a few years ago. Today he is one of our best customers. He says that the introduction of Durolites has reduced considerably their yearly expenses for blocks, sheaves and wire rope, because Durolites last longer and are easier on wire rope.

Similar results are reported by hundreds of other mine, pit and quarry operators and construction superintendents who now use Durolite Blocks exclusively. All of these buyers had used one or more different makes of blocks before trying Durolites. After switching to Durolites they found that they saved money in the long run and the light, easy-to-handle Durolites made friends among their workers. WRITE FOR CATALOG.

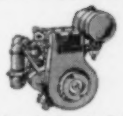
The sheaves and frames of Sauerman Durolite Blocks are of skeleton design and made from tough, high strength alloy steel, providing extreme lightness with great durability. Furnished either with roller bearings or bronze bearings ingeniously designed to take up end thrust and prevent sheave from contacting the frame. A bead cast on inside of frame protects edge of sheave flange. For underground work, Durolites are made with a wide throat that permits running of knotted ropes.

SAUERMAN BROS., INC.

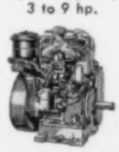
548 S. CLINTON St., CHICAGO 7

Manufacturers of famous Crescent Scraper

No. 1 Source FOR HEAVY-DUTY *Air-Cooled* ENGINES



4-cycle Single Cyl.
3 to 9 hp.



4-cycle 2-Cyl.
7 to 13 hp.

V-type 4-Cyl.
15 to 30 hp.

As a potential or present user of internal combustion engines, you will readily recognize the advantages of dealing with an outstanding leader in this field.

Because constant engineering effort and manufacturing skill are applied entirely to the improvement and large volume production of WISCONSIN HEAVY-DUTY AIR-COOLED ENGINES, in a complete, all-purpose power range, you have the best assurance not only of dependable power units ideally suited to your power applications but, of equal importance . . . you have, here, the world's most dependable source of supply both for engines and original factory parts.

Supporting this endeavor are key distributors of impressive recognition in the territories they serve, and a staff of competent Wisconsin Motor Corporation field men, in close liaison between factory and customer. Your best interests are our primary interest.

MOST H.P. HOURS

WISCONSIN MOTOR CORPORATION

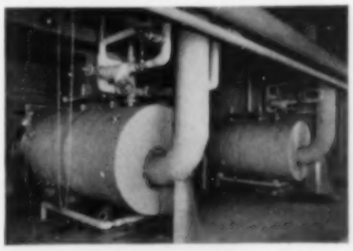
World's Largest Builders of Heavy-Duty Air-Cooled Engines

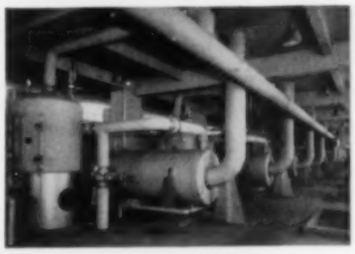
MILWAUKEE 46, WISCONSIN

MAXIM HEAT RECOVERY SILENCERS

produce "all the steam required"

FOR HYPERION SEWAGE DISPOSAL PLANT





In Los Angeles at the big Hyperion Sewage Disposal Plant, Maxim Heat Recovery Silencers provide all the steam necessary for plant heating as well as for heating the sludge.

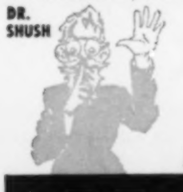
This outstanding installation highlights the practicality of Maxim Heat Recovery Silencers. Here is efficient use of waste exhaust heat that would otherwise just go "up the flue" to the outside atmosphere. The extra fuel cost for this usable heat is zero because the only fuel involved is that normally used for engine operations.

More and more industrial plants are combining effective silencing of engine exhaust with this efficient method of producing steam for heating or processing operations. Our Heat Recovery Silencer bulletin offered below gives details. Send for it today.

SEND FOR BULLETIN

THE MAXIM SILENCER COMPANY

61 HOMESTEAD AVE.
HARTFORD 1, CONNECTICUT



Please send HEAT RECOVERY SILENCER bulletin.

Name ____________________

Company ____________________

Address ____________________

BE SURE IT'S A

MAXIM

now available

12 PAGES OF COMPLETE INFORMATION ON

FLUOR MUFFLERS

Fluor "D" Series
MUFFLER SYSTEMS
Series T
AIR-COOLED
OPEN HERE
ENGINEERING DATA AND SELECTION

. . . a guide
for your
preliminary
study
of mufflers
and
muffling
requirements

This new Fluor muffler bulletin is designed to assist you in the selection and sizing of mufflers for 2- and 4-cycle internal combustion engines in the 150 to 2400 H.P. class.

It is a concise presentation of engineering data complete with cutaway and dimensional drawings and sizing and engine selection tables – ideal for preliminary study of muffling requirements or for specifying the type muffler best suited for your particular requirements.

A Few of the Subjects Covered . . .

- Design principles and applications for air-cooled and non-air-cooled mufflers.
- Cutaway drawings of both single and dual element mufflers.
- Dimensional drawings and tables of sizes and weights.
- Recommended sizes according to engine model numbers and horsepower ratings.
- Mufflers for Twin-Tandem Horizontal Gas Engine-Driven Compressor Units.
- Standard Models and arrangements of single and dual element mufflers.
- Basic design data required for quotation.

SPECIFY FLUOR BULLETIN NO. FM-8501
GET YOUR FREE COPY BY POST CARD OR LETTER

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MANUFACTURERS of Mufflers, Pulsation Dampeners, Gas Cleaners, Cooling Towers and Fin-Fan Units.
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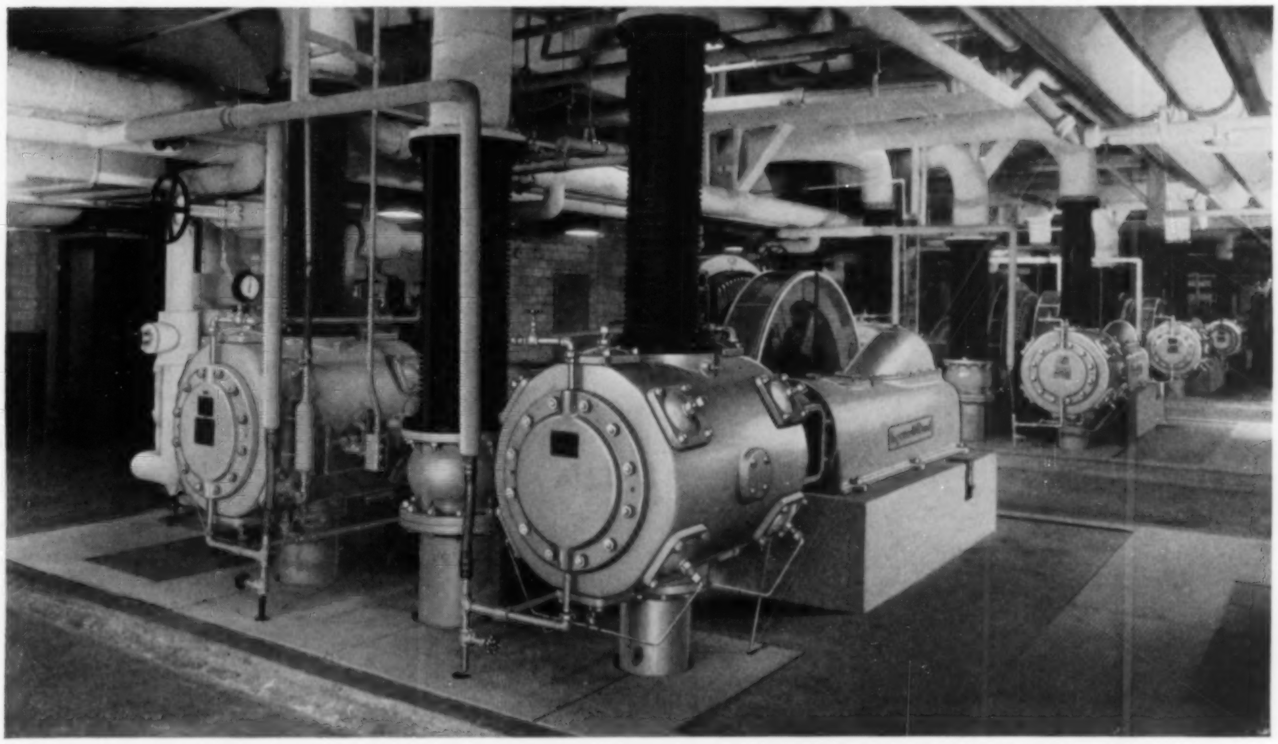
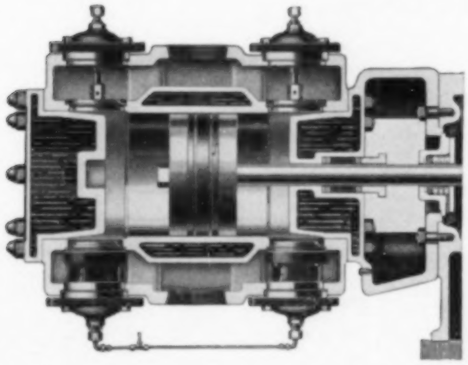
REPRESENTED IN THE STERLING AREAS BY: Head Wrightson Processes Ltd., Teesdale House, Baltic St., London, E.C.I., England

PRODUCTION OF CHLOROMYCETIN DEMANDS STERILE AIR





Advantages of Ingersoll-Rand "NL" Cylinders

The Ingersoll-Rand "NL" cylinder achieves oil-free compression without the use of tail rods or secondary crossheads. The weight of the piston is supported by graphitic-carbon wearing rings which prevent metallic contact between the piston and the honed cylinder bore. Compression rings are also carbon ... metallic inner expanding rings giving the proper wall pressure. Because the carbon rings are self-lubricating, the need for any conventional lubricant is completely eliminated. Wearing rings can be adjusted to maintain the proper clearances.

Four Ingersoll-Rand "NL" Compressors Supply Air for Mold Growth in Parke, Davis & Co. Plant

In its Detroit plant, Parke, Davis & Co. is producing Chloromycetin by both biological and synthetic processes. The biological method includes an air-activated fermentation process that must be free from any contamination.

Air for activating the mold growth is compressed to about 40 psig by four Ingersoll-Rand XRE electric-driven compressors. Since any oil or other lubricant used in the compressor cylinders would contaminate this air, the compressors are fitted with Ingersoll-Rand "NL" *non-lubricated* cylinders. Other precautions to assure sterile, contamination-free air to the fermentation tanks include electrostatic filters on the compressor intake, moisture-removing aftercoolers, and stainless-steel mesh and carbon sterilizing filters.

For such services demanding oil-free air or gas, Ingersoll-Rand builds standard lines of compressors fitted with "NL" *non-lubricated* cylinders. Sizes range up to 300 hp for handling air or any gas up to a discharge pressure of 2500 psi. Consult Ingersoll-Rand engineers on how you can use "NL" compressors for your process or instrument-control.

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